SACRAMENTO AIR LOGISTICS CENTER MCCLELLAN AFB CA SERV--ETC F/G 22/2 RESULTS OF A SURVEY SOFTWARE DEVELOPMENT PROJECT MANAGEMENT IN --ETC(U) DEC 79 J H LEHMAN, R H THAYER SM-ALC/MME-TR-79-54-VOL-1 NL AD-A117 997 UNCLASSIFIED 1002 A 7997



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18 December 1979



RESULTS OF A SURVEY
SOFTWARE DEVELOPMENT PROJECT MANAGEMENT
IN THE U.S. AEROSPACE INDUSTRY

VOLUME I

COMPANY ENVIRONMENT, ORGANIZATION AND PROCEDURES

JOHN H. LEHMAN
CALIFORNIA STATE UNIVERSITY
SACRAMENTO, CA 95819

AND

RICHARD H. THAYER

SACRAMENTO AIR LOGISTICS CENTER

AIR FORCE LOGISTICS COMMAND

MCCLELLAN AFB, CA 95652

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ABSTRACT

RESULTS OF A SURVEY SOFTWARE DEVELOPMENT PROJECT MANAGEMENT IN THE U.S. AEROSPACE INDUSTRY

Volume I: COMPANY ENVIRONMENT, ORGANIZATION AND PROCEDURES

BY

JOHN H. LEHMAN AND RICHARD H. THAYER

This report contains the results of a survey conducted in 1977 and 1978 on how the U.S. Aerospace Industry manages its software development projects. The sample of the U.S. Aerospace Industry that was surveyed consisted of those firms and companies with a membership in the AIAA Technical Committee on Computer Systems. These committee members represented 47 major corporations or major corporation subdivisions and occupied top positions in software management within their firms.

The survey used a rather lengthy questionnaire containing 225 numbered questions, however approximately 1,328 separate responses were possible. The survey was divided into three parts. Part One deals with defining the total organization, management structure, requirements, and philosophy of the firm and was intended to be answered by top management to provide the backdrop against which the individual projects would be viewed. Part Two concerns questions about individual projects which were aimed at, and intended to be completed by, the project manager. Part Three was primarily designed to obtain the opinions and perceptions of the project managers developing software on how they viewed major issues and/or major projects of software engineering project management.

This paper reports on only a portion of the answers to the questionnaire - Part One, the project environment. The other portions - dealing with the actual projects, and software development problems - are reported in Volumes I and III.

The answers have been condensed and/or coded and recorded on a tabulation sheet in this report. In addition, the narrative portion of the survey is recorded in clear text with all references to individuals and/or their companies deleted. This report does not attempt to analyze or come to conclusions about the data, only to report it as clearly as possible.

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APPENDIX D	NARRATIVE AND CANDID (CLEAR TEXT) ANSWERS TO SELECTED QUESTIONS

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SECTION 1 RESULTS

BACKGROUND

In the spring and summer of 1977, a survey was conducted on the U.S. Aerospace Industry to determine what management techniques and procedures they were employing in software development projects. It was originally accomplished to collect data for analysis and the preparation of a paper on Software Engineering Project Management, to be presented at the American Institute of Aeronautics and Astronautics (AIAA) Conference, Computers in Aerospace, 31 Oct-2 Nov 1977.

The sample of the U.S. Aerospace Industry surveyed consisted of those firms and companies with a membership in the AIAA Technical Committee on Computer Systems who were hosts to the conference. These committee members represented 47 major corporations, or major corporate subdivisions, and occupied top positions in software mangaement within their firms. They were, therefore, in an ideal position to report on how their segment of the U.S. Aerospace Industry managed its software development projects.

Initial contact was made in May 1977 to determine which members of the complete would be interested, willing, and able to participate.

Forty-five members, representing 35 companies, agreed to respond. The initial draft of the survey was completed in June 1977 and critiqued by approximately 25% of the total committee membership. The results of this critique, along with other corrections, were incorporated into the final survey. The survey was mailed 10 August 1977. On 6 September 1977, with 29 of the completed surveys on hand, the authors of the survey wrote the first report for the proceedings of the Conference, Computers in Aerospace. This paper can be found in the Conference Proceedings, A Collection of Technical Papers. By the time the actual presentation was

given on 1 November 1977, questionnaires from 33 companies representing 55 projects had been received. These companies, predominantly aerospace firms with government contracts, reported mostly on large to very large projects. The presentation given (called Report Nr 2, AIAA Project Management Survey) differed from the paper in so far as it used the more complete data and a different approach.

The survey did not end there, for completed forms continued to arrive until, by the summer of 1979, 66 projects representing 38 firms for a 86% return rate had been received (see Appendix A for a list of participants). A decision was made by the AIAA Technical Committee on Computer Systems to make further use of the data by writing an assessment paper on the state-of-the-art in software development project management. Mr Gene F. Walters, General Electric Co., Command and Information Systems, Sunnyvale, California and Mr Jack E. Bloodworth, Boeing Aerospace Company, were given primary responsibility for this paper. In addition, the Rome Air Development Center (RADC), the Boeing Aerospace Company and the Sacramento Air Logistic Center offered their services, and in some cases the services of their company's data processing capability to reduce and analyze the data.

The remaining problem was to reduce the data into a form useable by a computer. This involved "coding" the narrative and free form answers of the survey and verifying their consistency.

PURPOSE OF SURVEY

As previously stated, the purpose of this survey was to look at a sample of the U.S. Aerospace Industry through the use of a questionnaire to determine how they managed software development projects.

Specifically, the questions that the survey attempted to answer were:

- What are the current practices in Software Engineering Project Management today?
- 2. Are the new developments in management, i.e., "modern" management techniques or project management techniques, being used?

- 3. What are the trends in Software Engineering Project Management?
- 4. What are the relationships between Software Engineering Project Management techniques and successful delivery of software?
- 5. What are the relationships between various parts of Software Engineering Project Management as a system?
- 6. What are the relationships between "modern" Software Engineering techniques and Software Engineering Project Management?

THE SURVEY

The approach taken in determining answers to these questions was to first design a model for software engineering project management as a system and define the elements of that model and the relationships between these elements, and second, develop a questionnaire around this model using the various elements and/or variables as questions and possible responses. The survey contained 225 numbered questions and, by use of "questionnaire packing techniques," allowed for approximately 1,328 separate responses.

The survey, which contained 72 pages, was divided into three parts. Part One dealt with defining the total organization, management structure, requirements, and philosophy of the firm and was intended to be answered by top management to provide the backdrop against which the individual projects would be viewed. Part Two concerned questions about individual projects and was intended to be completed by the project manager. Part Three consisted of general questions, not project specific, calling for evaluation, opinions, and suggestions on the major problems of software engineering project management. It was also intended to be completed by a project manager.

PURPOSE OF THIS REPORT

This paper has been prepared to report the answers to Part One of the questionnaire in "raw" form so that they may be entered into a computer data base as well as to satisfy the many requests received from the computing community for access to the data collected as a result of this survey. The answers to Part Two, Part Three are provided in Volumes II and III.

Because of the restrictions placed by the participants on the use of their submissions, the actual completed surveys cannot be distributed and have been destroyed. This report was selected as a means of documenting and capturing as much of the "raw data" as possible without any possibility of revealing its source. In essence, this report does not contain "raw data" but reduced data in abbreviated and coded form that efficiently separates it from its source while allowing interested computer scientists its use for their own requirements.

This report does not attempt to analyze or come to conclusions about the data, only to report it as clearly as possible. Only minimum interpretation was made to enable the answers to be tabulated for eventual analysis. Although 38 companies reported (on 66 projects) only 34 Part Ones are reported: One company was too small and did not fit the norm, one company did not report a Part Two or Three, qnd two companies did not report a Part One.

CONTENTS OF THIS REPORT

As already stated, the purpose of this report is <u>not</u> to analyze the data from the AIAA Project Management Survey, but to report it as simply and accurately as possible, and to keep within the original ground rules of maintaining anonymity of the participants. Section 2 contains the questions and answers to this survey and Section 3 contains cited references. The participants in the survey are listed in Appendix A.

A duplicate copy of the questionnaire is in Appendix B. The questionnaire is included to allow the reader easy access to the questions and predefined answers to provide a ready familiarity with the type of material covered.

Appendix C contains the abbreviations used in reporting the narrative portions of this survey. Since the reduction of comments to code destroyed some of the richness of prose, the author felt it worthwhile to include the actual responses and these are recorded in Appendix D. To maintain the concept of protecting the participants' identity, the narrative answers cannot be tied to any project reported in Section 2.

THE FUTURE

This survey is, as far as the author can determine, the first attempt to query an industry on such a large scale to discover how their software engineering projects are managed. A look at the list of contributors in Appendix A will attest to the significance of this base of answers. The tremendous volume of data collected and the excellence of the responses dictates that this store of information be made available as reference material for papers, reports, texts, and other technical publications which might benent the U.S. Aerospace Industry or the data processing community at large. The AIAA Technical Committee on Computer Systems is anticipating the preparation of an assessment paper on industries management of software engineering projects. This committee welcomes suggestions from the computing and aerospace communities on how to best use this data for the benefit of all. Suggestions should be sent to either:

Mr Gene F. Walters
Mgr, Software Technologies
Information Systems Programs
General Electric Company
1277 Orleans Drive
Sunnyvale, CA 94086
(408) 734-4980

Mr Jack E. Bloodworth Mgr, ALCM Software The Boeing Aerospace Company MS-45-70 P.O. Box 3999 Seattle, WA 98124 (206) 655-6718

The Rome Air Development Center (RADC) has contracted with ITT Research Institute (IITRI) to establish and operate a software information analysis center. The center has been named the Data and Analysis Center for Software (DACS). One of the functions of DACS is to acquire and analyze data gathered during the various phases of the software development process with the purpose of identifying and quantifying those factors which contribute to the production of quality software. The data from this survey has been contributed to DACS and is available for analysis by any member of the AIAA Technical Committee on Computer Systems as well as the general computer community. Personnel interested in

receiving copies of this data, or requesting analysis of this data should contact:

Ms Lorraine Duvalle
Data & Analysis Center for Software
RADC/ISI
Griffiss AFB, NY 13441
(315) 336-0937

ACKNOWLEDGEMENTS

In addition to the contributors listed in Appendix A, the author wishes to acknowledge the support and dedication of the following people: From the Sacramento Air Logistics Center

Personnel who provided programming and analyst support are: Ms Bonnie J. Nieland, Mr Robert D. Heckler, Mr Grover "Bob" Collins, Mr John W. Robino, and Mr David E. Sturdevant.

The following individuals provided typing, proofreading, and composing support: Mrs Terry L. Meyer, Mrs Beryle E. McPheeters, Mrs Marianne L. Mueggenburg, and Mrs Betty J. Smith.

From the Boeing Aerospace Company

The Boeing Company's integrated logistic and systems maintenance team, consisting of Mr D. H. Wilson, Mr G. R. Herrold, and Mr W. B. Dalrymple, provided support in the areas of data reduction, data base structure, and file updating and verification. Dr Kenneth A. Hales, 1977 president of the AIAA Technical Committee on Computer Systems, provided the support of his committee in testing and completion of the questionnaires.

From the General Electric Company, Space Division

The Information Systems Program in Sunnyvale provided technical consultant support, proofreading, printing and encouragement through the services of Mr Gene F. Walters and his technical group.

From the Rome Air Development Center

RADC had offered to perform analysis of the data for the benefit of the U.S. Air Force, the AIAA Technical Committee on Computer Systems, and the computing community. Personnel responsible for this are: Mr Donald Roberts and Mr Alan R. Barnum. Ms Lorraine Duval, ITT Research Institute, who is general manager of the RADC Data and Analysis Center for Software (DACS), became the custodian of the data from this survey.

Special Acknowledgements from Sacramento, California

Mr Walter L. Antwiler from Sacramento, California spent many hours coding and recoding the survey answers for computer analysis. Mrs Mildred C. Thayer, Ms Lauren M. Thayer and Miss Meg L. Astleford proofread the typed copies and checked machine listings.

ATTACHMENT 1 TO SECTION 1

RELATIONSHIPS BETWEEN REPORTS

The survey was comprised of three parts, each dealing with a separate facet of software engineering project management. Part One dealt with the firm and the environment in which the project was done. Part Two was devoted to specific software engineering projects accomplished within the firm. Part Three asked the project managers their opinions about project management. Each of these parts can stand alone. Part One, reported in this volume, centers on the organization, management policies, staffing techniques and project controls of the companies that completed project questionnaires reported in Part Two.

Part Two, reported in Volume II of this report series, provided both detail and summary information on each project for which a valid questionnaire was returned. Each questionnaire could be considered a case study in project management. Part Three, reported in this Volume III of this report series, concerns ideas and perceptions about software engineering project management but does not relate to a given project or company.

At the same time, there is a relationship between these reports. Table I tells the relationships between Volumes I, II and III of this report.

TABLE 1 (ATTACHMENT 1 TO SECTION 1)

RELATIONSHIPS OF PROJECTS REPORTED IN ALAA

PROJECT MANAGEMENT STOVEY VOLUMES I, II AND III

Survey	VOL I	VOL II	VOL III
Identification Nr (1)	(Part One) (2)	(Part Two) (3)	(Part Three) (4)
101	30	101	Yes
102	30	102	Yes
103	30	103	Ye s
104	31	104	Yes
105	33 (8)	105	Yes
106	34 (8)	106	Yes
107	35	107	Yes
108	35	108	Ye s
109	35	109	Yes
110	36	110	Ye s
111	36	111	Yes
112	39 (9)	112	Yes
113	40 (9)	113	Yes
114	41	114	Ye s
115	69	115	No
116	42	116	Non e
117	43	117	Yes
118	45	118	Ye s
119	45	119	Ye s
120	51	120	Ye s
121	66 (5)	121	Ye s
122	51	122	Ye s
123	51	123	Ye s
124	51	124	Ye s
125	52	125	Yes
126	55	126	Ye s
1 27	No ne	127	Yes
128	59	128	No
129	No ne	129	Yes
130	31	130	Ye s

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FOOTNOTES FOR TABLE 1

- (1) Column 1 This column lists the returned surveys according to a randomly assigned identification number.
- (2) Column 2 The company identification number listed in column 2 is used in Vol I. In some cases, the same company was reported on by two or more individuals which resulted from two or more project managers reporting on different projects within the same company. In most instances these "double" reports were the same. Comments along these lines are contained in foot notes (5) through (12).
- (3) Column 3 This column lists the project numbers reported in Vol II. Projects with the same company numbers are from the same company or major subdivision.
- (4) Column 4 Vol III reports on data from Part Three. This column indicates whether or not the same person reported/wrote Part Two and Part Three of the survey. This is done so that the reader will know if there is any relationship between the project reported on in Part Two and the surveyee's opinions on the major problems of software development management.
 - (5) Company 25 and 66 are the same.
- (6) Very small company. Part Three is reported as Part Three of Project 201.
- (7) Company 27, 28 and 63 are the same. Answers reported under company 28 looked to be the most accurate and complete. Part Three of company 63 is reported as Part Three of Project 116.
- (8) Company 33, 34 are the same. Answers reported under company 33 looked to be the most accurate and complete.
 - (9) Company 39 and 40 are the same and have identical answers.
- (10) Company 46, 47 and 48 are the same. Answers reported under company 46 are considered to be the official answers by the surveyee.
- (11) Company 53 and 54 are the same. Answers reported under company 54 looked to be the most accurate and complete.
- (12) Project reported under project 304 was too large to be included.

SECTION 2 THE DATA

INTRODUCTION

This section reports on the actual data submitted by the participants on sixty aerospace projects. It is reported in tabulated, abbreviated and coded form and cannot be used completely without Appendix C. Every effort was made to disguise the contributor, including the deletion of some revealing data.

The questionnaire contained many different styles of questions: true or false, multi-choice answers, multi-part questions, fill-in-the-blanks, and narrative. Despite this multitude of styles, a common method of reducing and reporting the answers was developed (see Appendixes B and C). Multi-part questions were broken into separate questions through the use of part numbers (i.e., 01, 02, 03, etc.) and sub-part designators (a, b, c, d, etc.).

Each question is handled separately and reported as an array. The horizontal indices of the array refer to anonymous project identification numbers (see Section 1 for further explanation). The vertical indices refer to the question, part, and sub-part number. Every narrative answer has been coded or abbreviated by a three-character alphanumeric.

Generally speaking, the printing of a three-character alphanumeric opposite the sub-part of a question idicates that the participant answered "yes" or "true" as it applies to that part of the question. If a given question has a "blank" for an answer this idicates the surveyee answered "no" or "false" as pertains to that part of the question. With the exception of "none" or "missing" the alphanumeric is a code or abbreviation of a text answer that modifies the "yes" answer. The interpretation or meaning of the codes can be found in Appendix C. The author made every attempt to use codes that were easy to recognize (mnemonic).

In order for the reader to compare company environment to projects developed, the results are listed under the project identification number. This results in redundant reporting when a company reported on more than one project. Also, as reported in Section 1, sometimes more than one individual reported on the same company or firm. (The preferred report is reported on in Table 1 of Section 1). For those readers that want to compare results between companies, only the results reported on under the following projects should be used:

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118	120	121	125	126
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206	208	210	211	213
217	219	220	221	222
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Companies that reported on projects 127 and 129 did not fill out a Part One.

The questionnaire as printed in this report is a modified version of the questionnaire as originally answered (see Appendix B, Questionnaire, for explanation).

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SECTION 3 REFERENCE

INTRODUCTION

In preparing this survey, literally hundreds of books, articles, and papers were read. The results of this literature search became a general model of how software engineering project management was accomplished. This model is represented by the original questionnaire. It would be impractical in an informal report such as this to list all these publications particularly since many of the ideas contributed were general across many different publications. However, where one document was the source of nost of one question (or a group of questions) or a unique definition was used (i.e., structural programming, HIPO, Chief Programmer, Orthodox Job Enrichment, etc.) a reference is given. We hope nobody was slighted.

REFERENCE S

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APPENDIX A

CONTRIBUTORS

INTRODUCTION

This appendix lists those individuals (usually project managers) and firms who completed the survey. This list is provided to: (1) acknowledge the contribution, hard work, and willingness to contribute to the general knowledge of computer science by these individuals, and (2) to lend credibility to this report by making visible the excellent source of the data.

These people and companies are all members and supporters of the AIAA Technical Committee on Computer Systems.

At the end of this list is a group of individuals that wished to remain anonymous in order that they could provide more candid, truthful answers.

It was obvious from the answers received that the contributors worked very hard making the answers as truthful as possible. Again, the authors thank you.

CONTRIBUTORS

Mr. Philip S. Babel Technical Advisor for Computer Systems Acquisition

Mr. Francis J. Barrett Chief, PEACE SIGMA Development Unit

Mr. Frank L. Bernstein Vice President Federal Systems Division

Mr. Herman S. Binder Section Head, Systems Design Analysis & Integration Section Simulator Systems Program Office Aeronautical Systems Division Wright-Patterson AFB, OH 45433

Data Automation Branch Sacramento Air Logistics Center McClellan AFB, CA 95652

CALCULON Corporation 1501 Wilson Boulevard Arlington, VA 22209

Grumman Aerospace Corporation Bethpage, NY 11714

PRECEDING PAGE BLANK-NOT FILED

Mr. M. Lenard Birns Program Manager, Naval Warfare Gaming System

Mr. Jack E. Bloodworth Manager, ALCM Software

Mr. David A. Brown Chief, ARRCS Development Group

Mr. Allen G. Burgess Manager, Computer Systems Laboratory

Mr. George R. Cannon, Jr. Manager of Vandenberg Programs

Mr. Frank J. Cerulli
Director of Engineering
Computer Systems Division
also
Products Systems Division

Mr. James P. Chilton Director, Data Processing Sub Systems Systems Technology Program

Mr. Arthur C. C.ccolo Associate Division Leader Computer Science Division

Mr. James W. Clark Manager of Engineering Operations

Mr. Jerry E. Cummings Program Analyst Logistics Research & Systems Division Defense Systems Division Computer Sciences Corporation 304 West Route 38, Box N Moorestown, NJ 08057

The Boeing Aerospace Company P. O. Box 3999 Seattle, WA 98124

Data Automation Branch Sacramento Air Logistics Center McClellan AFB, CA 95652

Equipment Division Raytheon Company 528 Boston Post Road Sudbury, MA 01776

Logicon, Incorporated P. O. Box 1567 Vandenberg, CA 93437

Lockheed Electronics Company, Incorporated U.S. Highway 22 Plainfield, NJ 07061

McDonnel Douglas Astronautics Company 5301 Bolsa Avenue Huntington Beach, CA 92647

The Charles Stark Draper Laboratories, Incorporated 555 Technology Square Cambridge, MA 02139

United Technologies Research Center East Hartford, CT 06108

Directorate of Plans & Programs Sacramento Air Logistics Center McClellan AFB, CA 95652 Mr. G. Russell Curtis Manager, Simulation & Data Systems Information Systems Programs

Mr. Alan J. Deerfield Consulting Scientist

Mr. Edward M. Dunaye Director, Quality Assurance

Mr. Joe N. Dyer Manager, Equipment Evaluation & Systems Programming

Mr. Richard R. Erkeneff Chief Design Engineer, Data Control & Processing Systems

Mr. S. G. Evetts Project Manager

Dr. George R. Fath Acting Manager Avionics Development Engineering

Mr. Herb Finnie Manager, PLSS Software Development

Mr. J. I. Freeman Avionics Project Engineering

Dr. Virgil "Smokey" V. Griffith Chief, Electronics Engineer Digital Computer & Software Engineering General Electric Company 450 Persian Drive Sunnyvale, CA 94086

Submarine Signal Division Raytheon Company P. O. Box 360 Portsmouth, RI 02871

Planning Research Corporation 7600 Old Springhouse Road McLean, VA 22101

Lockheed Missile & Space Company, Incorporated P. O. Box 504 Sunnyvale, CA 94088

McDonnell Douglas Astronautics Company 5301 Bolsa Avenue Huntington Beach, CA 92647

Vought Corporation P. O. Box 5907 Dallas, TX 75222

General Electric Company 901 Broad Street Utica, NY 13503

Lockheed Missile & Space Company, Incorporated P. O. Box 504 Sunnyvale, CA 94088

Vought Corporation P. O. Box 5907 Dallas, TX 75222

McDonnell Aircraft Company P. O. Box 416 St. Louis, MO 63166 Mr. Harvey I. Gold Manager, Software Technology Department

Dr. Kenneth A. Hales Manager, MSP Mission Control & Software

Mr. Uwe W. Ibs Design Specialist

Dr. Peter R. Kurzhals Director, Guidance, Control & Information Systems Division

Mr. John C. Lemanczyk Manager, Software Technology Development

Mr. Myron Lipow Senior Staff Engineer, Product Assurance Systems Engineering & Integration Division

Mr. Austin Maher Manager, Software

Dr. John H. Manley Assistant to the Director

Dr. Robert R. McCready Applied Mathematician

Mr. H. Lewis Parker Manager, Mini/Micro Based Systems Department

Dr. Leon Pressor President System Development Corporation 2400 Colorado Santa Monica, CA 90406

The Boeing Aerospace Company P. O. Box 3999 Seattle, WA 98124

Pomona Division General Dynamics Corporation P. O. Box 2507 Pomona, CA 91766

Headquarters National Aeronautics & Space Administration Washington, DC 20546

Grumman Aerospace Corporation Bethpage, NY 11714

Defense & Space Systems Group of TRW, Incorporated One Space Park Redondo Beach, CA 90278

Kearfoot Division The Singer Company Little Falls, NJ 07424

Applied Physics Laboratory The Johns Hopkins University Johns Hopkins Road Laurel, MD 20810

Vought Corporation P. O. Box 5907 Dallas, TX 75222

COMSTAT Laboratories 22300 Comstat Drive Clarksburg, MD 20734

Softool Corporation 340 S. Kellogg Avenue Goleta, CA 93017 AD-A117 997

SACRAMENTO AIR LOGISTICS CENTER MCCLELLAN AFB CA SERV-ETC F/G 22/2

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Dr. Terry A. Straeter Head, Programming Technologies Branch

Mr. Herbert D. Strong, Jr. Manager, ADP Management Office Flight Projects Support Office

Mr. R. L. Van Tilburg Senior Scientist Computer Programming Laboratory

Mr. Gene F. Walters Manager, Software Technologies Information Systems Program

Mr. Lynn S. Wilson Director, West Coast Operations

Mr. Eric W. Wolf Manager, Washington Operations

Anonymous Techniccal Advisor for Computers

Anonymous Manager, Communication Analysis

Anonymous Chief, Scientific Applications Analysis Branch

Anonymous Tech Director, Simulation Division

Anonymous Senior Engineering Specialist Avionics Software Langley Research Center National Aeronautics & Space Administration Hampton, VA 23665

Jet Propulsion Laboratory California Institute of Technology 4800 Oak Grove Drive Pasadena, CA 91103

Hughes Aircraft Company P. O. Box 3360 Fullerton, CA 92634

General Electric Company 450 Persian Drive Sunnyvale, CA 94086

Grumman Data Systems Corporation 16133 Ventura Blvd., Sutie 675 Encino, CA 91436

Bolt Beramek & Newman, Incorporated 1701 No. Fort Myer Drive Arlington, VA 22209

Engineering & Development Organization Large Government Agency (Military)

Electronic Systems
Large Manufacturing Company

Research Center Large Government Agency (Non-Military)

Software and Engineering Large Manufacturing Company

Aircraft Development Large Aerospace Corporation

APPENDIX B QUESTIONNAIRE

INTRODUCTION

This appendix contains Part One of the questionnaire. Other reports will contain the balance of the questionnaire.

The questionnaire as printed in this report is a modified version of the questionnaire as originally answered. This was done for the following reasons:

- (1) Not all questions had accompanying multiple choice answers but were narrative in nature.
- (2) The original questionnaire contains space for project managers to add their own comments as answers to the questions rather than select one of the pre-given answers, and
- (3) There were errors in the original survey which needed correcting.

The procedures used to report on those questions that did not have preselected answers was to modify the original questionnaire to make it "look like" the authors had preselected these possible answers and the participants had checked them. In truth, the answer set was derived from the submitted answers. To indicate which questions were originally narrative in form, a notation in parenthesis following the question will indicate "originally narrative."

In addition, the original questionnaire contained space for project managers to add their own comments as answers to the questions rather than select one of the pre-given answers. This was encouraged by the author in order to insure that the answers to the questionnaire were as accurate as possible and not distorted by forcing the participant to only select from pre-conceived answers. Again, to provide structure so the answers can be encoded in a computer data base system, the "comment" answers were grouped and the possible "answer set" expanded to include these answers. To indicate these additional answers the word "added" will be placed in parenthesis at the end of the question.

In contrast, Question 45 was left in narrative form. This question was answered by encoding the answers and entering this code on the tabulation sheets.

Other modifications were made to the original questionnaire where the participants indicated the question was poorly worded or where the participants modified the original question by the insertion of a word or phrase. The author inserted these in the interest of making this version of the questionnaire more complete. These additions to the original questions and/or original answers are indicated by placing the added portion in brackets "[]" and placing the word "added" in parenthesis at the end of the question or answer.

The author hopes that the above explanations do not appear to be too complex. It was done purely in the interest of conveying the maximum amount of information to the reader about the original questions and the possible answers presented to the respondent.

References were added where they were needed or where the addition of a reference would make the question clearer. An abbreviated source is contained in brackets "[]" and the complete source follows this appendix.

RULES AND CONDITIONS FOR PARTICIPATING IN SURVEY

It is important that no company, or individual suffer any loss of proprietary information or receive unfavorable publicity as a result of this survey. Each individual participating in the survey has our full assurance that the data he provides will be treated in accordance with the above principles. In order to achieve this we stipulate the following:

- 1. Unless specifically authorized, the names of participating firms, or individuals will not be listed in the report as contributors.
- 2. The anonymity of the company, department, individual, and project will be preserved in every instance.
- 3. Any proprietary or company confidential information, if so identified (by writing "CONF" beside the question) will be protected and used only in deriving statistical data.
- 4. The individual completing the questionnaire can omit the answer to any question without invalidating the questionnaire.
- 5. Only if cleared for further dissemination will raw data (completed forms) be made available to the participating AIAA TC members, should such request be made, to assist them in research work of their own. Without exception, all company, department, project, and individual names, as well as responses identified as "CONF" will be systematically deleted prior to release.
- 6. If so requested by the submitter, only statistical data will be derived from the survey, and the survey form destroyed upon publication of the final report.

Though it is seen as providing benefits to all participants, including the U.S. Air Force, this survey is not sponsored by the U.S. Air Force, or any individual, group, committee, or company, and does not imply any obligation on the part of the participants. It is being accomplished solely to provide data to be presented at the AIAA Conference, Computers in Aerospace, 31 Oct - 2 Nov 1977, Los Angeles, California.

PICHAPD H THAVES

OHN H ZEHMAN

MEMO OF UNDERSTANDING

be used: (Please sign each stipulation you wish to make as precondition to submitting this survey. Line through those paragraphs which do not apply.)
This survey with company, department, project and other identifying markings, and with all answers marked "CONF" deleted can be duplicated and provided to the TC members at their request.
Signature of Submitter
This survey can only be used to provide statistical data and cannot be released to the TC members for their use in any but a composite statistical or summary form. Following publication of final report both this form and the survey must be destroyed by shredding, pulping, or similar means.
Signature of Submitter
I authorize the release of the firm name in a list of participants to be included as an addendum to the final report. The desired name, title, etc., is:
Signature of Submitter

A SURVEY OF MANAGEMENT TECHNIQUES AND PROCEDURES

EMPLOYED IN SOFTWARE DEVELOPMENT PROJECTS

INSTRUCTIONS

Each survey packet comprises three parts. The number of packets provided will, in most cases, match the number of projects to be reported on plus one spare. If more forms are required you may copy or call.

PART ONE of the survey deals with defining the total organization and the overall management structure, requirements, and philosophy, and is intended to be answered by top management. It provides the backdrop against which the individual projects are to be viewed. Normally, only one copy of PART ONE should be completed per mailing, but each packet contains PARTS ONE, TWO, and THREE for the sake of uniformity and the chance that, in some instances, additional PART ONES would be called for.

A PART TWO is to be completed for each project reported on, and is intended to be completed by the <u>project manager</u>. (It is assumed the project is completed or almost completed) If those methods now often referred to as Modern Programmer Productivity Techniques (top down design, structured programming, et al.) are being used in whole, or in part, in your development activities, you should consider selecting a representative sample of before and after projects in completing the survey.

PART THREE consists of general questions not related to any specific project, and is also intended to be completed by a project manager. One PART THREE is included in each packet on the assumption that each project will be reported on by a different project manager. If one manager reports on more than one project, he or she would only complete PART THREE one time.

The dynamic nature and infinite diversity of the entire field of Data Processing has kept the jargon from becoming universally defined. For this reason we have attempted to avoid terms that might have more than one meaning. If questions appear vague or imprecise, feel free to call for clarification. Or, if you prefer, rewrite the question to ask what you believe the point to have been, or to relate it to your particular environment.

The answers provided for each question are not the universal set of possible responses, so, if you believe selecting one of the canned replies would be misleading please select "other" or "comment" and explain. If more space is required, write in the margins indicating the number of the question being answered. If a question defies

answering either through complexity, non-relevance to your environment, or excessive research feel free to leave it blank or enter an appropriate comment. If you write "CONF" in the left margin adjacent to any question, that response will be treated as confidential/proprietary data as described under "Rules and Conditions..", attachment 1 to the basic letter.

If possible, avoid direct reference to specific firms, projects, and people. Each set of questionnaires has been numbered in order that we might keep related responses together and facilitate accounting. Base numbers have been selected at random and no algorithym has been employed that would facilitate pairing firms with forms.

We very much appreciate the time and effort you're putting into this. Your time, effort, and candor are essential to the success of our joint effort.

Please return the completed surveys in the return envelope provided or mail to:

Colonel Richard H. Thayer SM-ALC/ACD McClellan AFB, CA 95652

A SURVEY OF MANAGEMENT TECHNIQUES AND PROCEDURES

EMPLOYED IN SOFTWARE DEVELOPMENT PROJECTS

PART ONE (Modified)

INTRODUCTION. PART ONE of the survey pertains to the company or firm as a whole (a major division of a very large corporation, e.g., IBM - Federal Systems Division, General Dynamics - Fort Worth, Grumman Data Systems Corporation, NASA Langley Research Center is considered to be an indepen-

deni def: requ	t com ining uirem	mpany/firm for the purpose of this survey). PART ONE deals with the total organization and the overall management structure, ments, and philosophy and is intended to be answered by a senior other senior manager in the company.	ı
THE	IDE	NTIFICATION NUMBER ASSIGNED TO THIS PACKET IS	
	ase :	return the completed Questionnaire in the envelope provided or :	
		Colonel Richard H. Thayer SM-ALC/ACD McClellan AFB, CA 95652	
1.	Wha	t position do you hold in the company? (Originally narrative)	
	а.	Senior Corporate Officer (President, Vice President, Executive Officer, etc)	[]
	b.	Senior ADP Officer	[]
	с.	Senior Functional Area (Non ADP) Manager (i.e., Director of Engineering, Manager Airframe Development, Chief of Production, Program Manager)	[]
	d.	Project Manager Software Development	[]
	e.	Technical Director, Quality Assurance, IV&V Supervisor, etc	[]
	f.	Senior Corporate Staff	[]
	g.	Project Individual	[]
	у.	None of the above	[]
	z.	Other/Comment if necessary	[]

a.	ally narrative) Corporate Officer (President, Vice President, Executive
	Officer, etc.)
ъ.	Chief (Vice President, Director, Managing Head) Data Processing (Computing, Information Systems, Data Services, Data Automation, etc.)
c.	Assistant Controller (Financial Manager, etc.)
d.	Software Analysis (Engineer, Developer, etc.)
у.	Not applicable to organizational structure
z.	Give Title/Comment if necessary
nior	t is the title/position of the individual to whom the ADP officer reports? (e.g., President, Comptroller) ally narrative)
a.	Corporate Officer (President, Vice President, Executive Officer, etc.)
b.	Comptroller (Vice President for Finance, etc.)
с.	Senior Functional Area (non ADP) Manager (Director/Chief of Engineering, Research, Operations, etc.)
d.	Functional Area Supervisors
у.	Not applicable to organizational structure
z.	Other/Comment if necessary
rectl velop	t are the titles/positions of the individuals reporting y to the senior ADP officer? (e.g., Chief, Software ment Division)
a.	
b.	
c.	
d.	
e.	

a.	Senior ADP officer (or)	to
ъ.	to c	to
d.	to e	to
f.	to g	to
h.	Software Development Project Manager	
у.	Not applicable to organizational structure	
z .	Comment if necessary	_
6. Soi	ftware Development Project Managers are normally:	
а.	Functionally oriented (accountant for accounting application, logistician for logistics application, [engineering, etc.] (added)	
ъ.	ADP management oriented	
c.	Senior software analysts	
d.	Senior software analysts/programmers	
e.	Professional Project Managers (generalist) (added)	
у.	None of the above (added)	
z.	Other:	_
	e firm is primarily: [Taken partly from Computer Survey iption Form, 1 June 1977]	
а.	A manufacturer of computer hardware	
b.	A manufacturer of other than computer hardware	
с.	A "software house"	
d.	An engineering service and technical support organization	
e.	The Government: federal (non-military), federal (military), state, county, municipal	
f.	A university or educational institution	
g.	A computer service bureau, time-sharing service	
h.	An ADP consultant and/or education service	
i.	Financial: banking, insurance, real estate, securities, credit	

	j.	In the wholesale or retail trade	ĺ
	k.	In medical or legal services	[
	1.	In transportation services	(
	m.	Utilities: communications, electric, gas	[
	z.	Other/Comment:	[
8.	The	firm is:	
	a.	Operated for a profit	{
	ъ.	Non-profit organization	[
	c.	Government agency	1
	у.	None of the above	ĺ
	z.	Other:	i
	ria,	firm has principal locations. (e.g., Factory in mine and smelter in Ashtabula, Home office in Newark: = ions)	
10. 10c	So: atio	ftware system development is carried on at of these ns.	
ll. yea		oss revenues (Budget for Government Agencies) for last ported (197_) were: (added)	
	a.	Less than 200 thousand dollars	1
	ъ.	Between 200 thousand and 1 million dollars	
	c.	Between 1 million and 10 million dollars	
	d.	Between 10 million and 50 million dollars	
	e.	Between 50 million and 100 million dollars	
	f.	Between 100 million and 500 million dollars	
	g.	Between 500 million and 1 billion dollars	:
	h.	In excess of one billion dollars	
	z.	Other:	
12. dev		at percent of [Total] revenue is derived from software ment? [For software developed for profit] (added)	
	a.	Less than 10%	
	b .	Between 10% and 25%	
	c.	Between 25% and 50%	
	d.	Between 50% and 75%	

f. All revenue derived from software development y. [Not Applicable]/All development done for in-house customers (added) z. Other:	e.	Over 75%	[]
customers (added) z. Other: [] 13. What percent of the [total profits] annual budget is devoted to software development activities? [For software not developed for profit/government agencies] (added) a. Less than 10% b. Between 10% and 25% c. Between 25% and 50% d. Between 50% and 75% e. Over 75% y. Not applicable (added) z. Comment: [] 14. How many people: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.' (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involveu [] f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) g. Software not developed for in-house use (added)	f.	All revenue derived from software development	[]
13. What percent of the [total profits] annual budget is devoted to software development activities? [For software not developed for profit/government agencies] (added) a. Less than 10% b. Between 10% and 25% c. Between 25% and 50% d. Between 50% and 75% e. Over 75% y. Not applicable (added) z. Comment: 14. How many people: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.' (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involveu f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added)	у.		[]
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b. Between 10% and 25% c. Between 25% and 50% d. Between 50% and 75% e. Over 75% y. Not applicable (added) z. Comment: 14. How many people: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.' (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added)	devote	to software development activities? [For software not	
c. Between 25% and 50% d. Between 50% and 75% e. Over 75% y. Not applicable (added) z. Comment: 14. How many people: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.' (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added)	a.	Less than 10%	[]
d. Between 50% and 75% e. Over 75% y. Not applicable (added) z. Comment: [] 14. How many people: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	ь.	Between 10% and 25%	[]
e. Over 75% y. Not applicable (added) z. Comment: [] 14. How many people: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.' (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involveu f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	с.	Between 25% and 50%	[]
y. Not applicable (added) z. Comment: [] 14. How many people: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.' (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added)	d.	Between 50% and 75%	[]
2. Comment: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	e.	Over 75%	[]
14. How many people: a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	у.	Not applicable (added)	[]
a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involveu [] f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) [] y. Software not developed for in-house use (added)	z.	Comment:	[]
a. Are employed by the firm b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involveu [] f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) [] y. Software not developed for in-house use (added)			
b. Work in all aspects of ADP c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	14. Ho	ow many people:	
c. Are devoted to Software Development activities z. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) [] b. Senior Functional Area Manager (added) [] c. Comptroller [] d. Director of data processing [Senior ADP official] (added) [] e. Executive one step above functional area involved [] f. Selection Committee (added) [] g. Project Manager (added) [] h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) [] y. Software not developed for in-house use (added) []	a.	Are employed by the firm	
2. Comments: [] 15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) [] b. Senior Functional Area Manager (added) [] c. Comptroller [] d. Director of data processing [Senior ADP official] (added) [] e. Executive one step above functional area involved [] f. Selection Committee (added) [] g. Project Manager (added) [] h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) [] y. Software not developed for in-house use (added) []	b.	Work in all aspects of ADP	
15. Who exercises approval authority for major software developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added)	с.	Are devoted to Software Development activities	
developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added)	z.	Comments:	[]
developed for in-house use? a. Corporate Officer (President, Vice President, etc.) (added) b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added)			
b. Senior Functional Area Manager (added) c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []			
c. Comptroller d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	а.	Corporate Officer (President, Vice President, etc.) (added)	[]
d. Director of data processing [Senior ADP official] (added) e. Executive one step above functional area involved [] f. Selection Committee (added) [] g. Project Manager (added) [] h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) [] y. Software not developed for in-house use (added) []	ъ.	Senior Functional Area Manager (added)	[]
e. Executive one step above functional area involved [] f. Selection Committee (added) [] g. Project Manager (added) [] h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) [] y. Software not developed for in-house use (added) []	c.	Comptroller	[]
f. Selection Committee (added) g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	d.		[]
g. Project Manager (added) h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	e.	Director of data processing [Senior ADP official] (added)	
h. Executive requesting system through some form of internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []	f		[]
<pre>internal budget scheme [Requirement Document] (added) y. Software not developed for in-house use (added) []</pre>	1.	Executive one step above functional area involved	
		Executive one step above functional area involved Selection Committee (added)	[]
z. Other: []	8.	Executive one step above functional area involved Selection Committee (added) Project Manager (added) Executive requesting system through some form of	[]
	g. h.	Executive one step above functional area involved Selection Committee (added) Project Manager (added) Executive requesting system through some form of internal budget scheme [Requirement Document] (added)	[]

16. In this question we wish to ascertain which forms of contract you employ and which you prefer in each of three situations. In responding you may either check the answer or provide a rank ordering of those answers that apply. The first situation related to your being the contractor providing software development for a user or customer. The second situation reverses this and places you in the user or customer role. The final situation concerns the form of agreement that is employed when software is developed for in-housers. [ASPR, 1976]

		A ! You as			D Contract		F lop for ouse Use
Con	tract Type	Use Pr	refer	Use	Prefer	<u>Use</u>	Prefer
a.	Firm fixed price	[]	[]	[]	[]	[]	[]
b.	Fixed price with economic price adjustment		[]	[]	[]	[]	[]
c.	Fixed price incentive	[]	[]	[]	[]	[]	[]
d.	Firm fixed price level of effort	[]	[]	[]	[]	[]	[]
e.	Cost	[]	[]	[]	[]	[]	[]
f.	Cost sharing	[]	[]	[]	[]	[]	[]
g.	Cost plus incentive fee	[]	[]	[]	[]	[]	[]
h.	Cost plus award fee	[]	[]	[]	[]	[]	[]
i.	Cost plus fixed fee	[]	[]	[]	[]	[]	[]
j.	Time and materials	[]	[]	[]	[]	[]	[]
k.	Labor-hour	[]	[]	[]	[]	[]	[]
1.	Basic ordering agreement	[]	[]	[]	[]	[]	[]
у.	None (added)		[]	[]	[]	[]	[]
z.	Other:	[]	[]	[]	[]	[]	[]

17. Do you use two phase contracts in which: phase one analyzes the requirements, determines feasibility, and estimates costs, and phase two directs development?

		<u>A</u>	<u>B</u>	<u>C</u>
		You are Contractor	You Contract For	Develop for In-House Use
a.	Always use them	[]	[]	[]
ъ.	Prefer them on projects of any size	[]	[]	[]
c.	Encourage their use on major projects	[]	[]	[]

d.	Sometimes use them (added)	[]	[]	[]
e.	Hardly ever use them (added	[]	[]	[]
f.	Discourage their use in all but extreme cases	[]	[]	[]
у.	Never use them	[]	[]	[]
z.	Comment:			
	an incentive clause is include normally based on?	ded in the co	ntract, wha	it is the
		<u>A</u>	<u>B</u>	<u>C</u>
		You are Yo Contractor	u Contract For	Develop for In-House Use
a.	Reduced cost	[]	[]	[]
b.	Early delivery	[]	[]	[]
c.	Increased performance	[]	[]	[]
d.	Quality factors	[]	[]	[]
у.	Not used (added)	[]	[]	[]
z.	Other:	[]	[]	[]
	te bonuses or incentives paid fare development projects? Yes, for key personnel Yes, for other than management yes, for all individuals engines, to project manager on yes, based on individual per yes, management incentive programment yes, higher award fee on con No (bonuses or incentive particular).	ent positions gaged full ti fixed price c rformance (ad rogram (added	me on the p ontracts (a ded)	[] [] roject []
bid on s	e procedures been employed in pecific tasks in the developme edit program for \$1,217.12 Yes No Comment:	ment of proje		

21. has		bidding as described above was employed, how successful croven to be?	
	a.	Very	[]
	ь.	Moderate	[]
	c.	Unsuccessful	[]
	у.	Not employed	[]
	z.	Useful only under the following condition(s)	[]
22.	In	most instances:	
	a.	Software development projects are handled within the ADP environment with functional analysts or prospective users being assigned or attached to the development team.	[]
	b.	ADP specialists are detailed or assigned to the functional user for the duration of the development effort.	[]
	у.	None of the above (added).	[]
	z.	Other:	[]
23.	a. b. c.		% % %
plac may	lopm e th be i	possible, outline the composition of a typical large ent team as it would be employed in your firm. To se team in context a hypothetical project description included (e.g., Development of an on-line air cargo ing capability).	
Нуро	thet	ical project description (optional):	
cons of t	ider he n	s may be used to indicate that the position is not ed a full time job. The following is an example otation to be used if one individual occupies n one position.	
	f.	Administrator 1/3 (g)	
	g.	Librarian DESIGN ASSISTANT 2/3 (f)	
		er in parenthesis is intended to tie the same individual ions f and g.	

		<u>A</u>	<u>B</u>
Fos	ition Title	Title Used by Your Firm	Number
a.	Project Manager		
b.	Asst. Proj. Mgr.		
с.	Senior Analyst		
d.	Team Chief		
e.	Asst. Team Chief		
f.	Administrator		
g.	Librarian		
h.	Application Anal.		
i.	Functional Anal.		
j.	Applications Prog.		
k.	Oper. Sys. Prog.		
1.	Tester		
m.	Integrator		
n.	Data Base Designer (added)		
٥.	Data Base Administrator (added)	
p.	Transition to Production Interface (added)		
q.	Quality Assurance (added)		
r.	Staff Assistant to Assistant Proj. Manager (added)		
s.	Documentation Aids (added)		
t.	Hardware Engineers (added)		
у.	None of the above (added)		
z.	Other:		

^{25.} What is the normal/typical progression to the position of Project Manager, e.g., programmer, analyst, lead programmer, project manager? [(Indicate by putting number opposite position used in order of progression starting with "1" on lowest position and ending with Project Manager)] (added) (Originally narrative)

a.	Associate Programmer	[]
ъ.	Junior Programmer/Analyst	[]
c.	Junior Analyst	[]
d.	Work Unit Leader	[]
e.	Assistant Engineer	[]
f.	Software Engineer	[]
g.	Associate Engineer	[]
h.	Programmer	[]
i.	Associate Programmer/Analyst	[]
j.	Senior Programmer	[]
k.	Systems Analyst	[]
1.	Programmer/Analyst	[]
m.	Lead Analyst	[]
n.	Lead Engineer	[]
٥.	Chief Avionics Engineer	[]
p.	Lead Programmer	[]
q.	Staff Programmer/Analyst	[]
r.	Head Programmer	[]
s.	Senior Programmer/Analyst	[]
t.	Task/Work Package Manager	[]
u.	Engineer	[]
ν.	Team Chief	[]
w.	Senior Systems Analyst	[]
aa.	Data Systems Specialist	[]
bb.	Supervisor	[]
cc.	Department Head	[]
dd.	Chief Engineer	[]
ee.	Senior Engineer	[]
ff.	Software Systems Engineer	[]
g g .	Software Development Manager	[]
hh.	Deputy/Associate Project Manager	[]
ii.	Scientific Programming Specialist	[]
jj.	Group Leader/Software Development	[]
kk.	Advisory Analyst	[]

	11.	Project Leader			[]
	mm.	Project Engineer			[]
	nn.	First Line Supervisor			[]
	00.	Second Line Manager			[]
	pp.	Engineering Manager			[]
	qq.	Project Manager			[]
	у.	No pattern			[]
	z.	Other:			[]
					-
26.	Are	applications analysts a	also computer p	rogrammers?	
	a.	Always			[]
	ь.	More than half of our a	analysts are als	so programmers	[]
	c.	Less than half of our a	analysts are al:	so programmers	[]
	d.	Very rarely is an analy	yst also a progi	rammer	[]
	e.	Varies depending on type	pe of work (adde	ed)	[]
	z.	Comment:			[]
and	anal	t is your approximate raysts (programmer/analys to indicate ratio] (add	ts)? [Fill in a	number opposite a o	r
	a.	Programmers			[]
	ъ.	Analysts/Programmer Ana	alysts		[]
	c.	Varies, depending on s	ituation		[]
	у.	None/very few straight	programmers or	analysts	[]
	z.	Comment:			[]
and	itori: how	ch manual reporting productions and management? At the solution of the solution of the solution of the solution as the solution of the solution as the solution of the solution of the solution of the solution as the solution as the solution of the solution of the solution as the solution of the solutio	what level do the ften are they a	ney originate, ggregated,	
			<u>A</u>	<u>B</u>	<u>C</u>
	j	REPORT TITLE	LOWEST ORIGINATOR	HIGHEST RECIPIENT	NO. OF AGGS/EDTS
	a.	Weekly Activity			
	ь.	Project Status			
	c.	Significant Change			
	d.	Cost vs Performance			

e.				
f.		_		
у.	No manual reporting [] system used/unknown		[]	[
z.	Comment:			[
	ich automated reporting systems are ing and management?	used i	n project	
			<u>A</u>	<u>B</u>
			LOWEST ORIGINATOR	HIGHEST RECIPIENT
а.	Manhour by Activity (e.g., code, flow diagram, etc.)			
b.	Manday by Task (e.g., prepare users guide, design data base etc.)			
c.				
d.				
у.	No automated reporting systems us	ed	[]	[]
z. Whi oyed	Comment:	eloped	software is	N,
z. Whi oyed ied f de	Comment:ich commercial, or what locally dev	eloped ? (e.g	software is ., LIBRARIA gin give ve	N,
z. Whi oyed ied f de	Comment: ich commercial, or what locally development task to assist in the development task Data Research) (If system is of locally continued pre-co	eloped ? (e.g	software is ., LIBRARIA gin give ve	N,
z. Whi oyed ied f de	Comment: ich commercial, or what locally development task to assist in the development task Data Research) (If system is of locality or assertation, e.g., structured pre-conters, etc.)	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic	N, ry if locally give bries
z. Whi oyed ied f de	Comment: ich commercial, or what locally devided it of assist in the development task Data Research) (If system is of localities as a scription, e.g., structured pre-conters, etc.) A	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries
z. Whi oyed ied f de char	Comment: ich commercial, or what locally devided it of assist in the development task Data Research) (If system is of localities as a scription, e.g., structured pre-conters, etc.) A	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries
Z. Whi oyed ied f de char	Comment: ich commercial, or what locally devided it of assist in the development task Data Research) (If system is of localities as a scription, e.g., structured pre-conters, etc.) A	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries
z. Whi oyed ied f de char a.	Comment: ich commercial, or what locally devided it of assist in the development task Data Research) (If system is of localities as a scription, e.g., structured pre-conters, etc.) A	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries
Whi oyed ied f de char a. b.	Comment: ich commercial, or what locally devided it of assist in the development task Data Research) (If system is of localities as a scription, e.g., structured pre-conters, etc.) A	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries
whi oyed ied f de char	Comment: ich commercial, or what locally devided it of assist in the development task Data Research) (If system is of localities as a scription, e.g., structured pre-conters, etc.) A	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries
whi oyed ied f de char a. b. c. d.	Comment: ich commercial, or what locally devite assist in the development task Data Research) (If system is of locality of secription, e.g., structured pre-conters, etc.) A NAME	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries
z. Whioyed ied f dechar	Comment: ich commercial, or what locally devite assist in the development task Data Research) (If system is of locality of secription, e.g., structured pre-conters, etc.) A NAME	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries
whi oyed ied f de char a. b. c. d. e. f.	Comment: ich commercial, or what locally devite assist in the development task Data Research) (If system is of locality of secription, e.g., structured pre-conters, etc.) A NAME	eloped ? (e.g	software is ., LIBRARIA gin give ve , automatic B Vendor, or developed,	N, ry if locally give bries

develop	you purchase software aids/packages from external ers approximately what percent is purchased (versus ed in-house)?	
	es the firm have a special organization or group that e project manager in selecting software development ckages?	
a.	Yes (Title:	_) []
ъ.	No	[]
z.	Comment:	_ []
	e software aids primarily written in assembly language sed to a higher order language such as COBOL?	
а.	Yes	[]
b.	No (what language):	_ []
c.	Varies widely (added)	[]
у.	None used (added)	[]
z.	Comment:	_ []
supplie	ich software development aids (e.g., copy library) d by the hardware manufacturer do you use to assist ication system development?	
	<u>A</u> <u>B</u>	
	NAME Manufacturer	
a.		
b.		
c.		
d.		
e.		
у.	Don't use any of them	[]
35. In used to	monitoring system development, system software is :	
a.	Count compiles per modules	[]
b.	Count lines of code produced	[]
c.	Check for adherence to coding conventions	[]
d.	Check for use of standard data element names	[]
е.	Measure spare time (added)	[]
f.	Restrict access to specific areas of memory (added)	[]
g.	Keep track of data sets and storage usage (added)	[]
h.	Monitor execution time (added)	[]

	i.	Number of times program modules are executed (added)	[
	<u>.</u> †.	Monitor Queue (length) (added)	[
	k.	Provide proper timing information (added)	[
	1.	Provide program resource utilization data (added)	[
	у.	Do not use software to monitor system development	[
	z.	Other:	[
	, pr	t manually derived productivity indexes such as lines of ogram errors, turn arounds required per completed task, at you employ in monitoring performance.	
	a.		
	b.		
	c.		
	d.		
	e.		
	у.	Don't use productivity indexes	[
37. chec		you are presently using on-line, interactive programming, d fill in those answers which apply.	
	а.	We are presently starting to use on-line interactive programming.	1
	ь.	We have been using on-line, interactive programming since 19	
	c.	We presently employ on-line, interactive programming on	
	у.	Do not use on-line, interactive programming	(
	z.	Comment:	(
38. prog		experience to date indicates that on-line, interactive ing is:	
	a.	A highly effective development tool	1
	b .	Effective is some cases	1
	c.	Of limited utility	ı
	d.	A drain on hardware resources	
	e.	Inefficient use of personnel (expensive) (added)	ļ
	f.	A nice toy	
	у.	No experience with on-line, interactive programming	
	z.	Other:	1

mosr er	fective? (Check or rank order)	
а.	During development of code	
ъ.	To try short length of code for possible use (simulation approach)	
c.	During debugging	
d.	During testing	
e.	During routine runs (added)	
f.	To do quick and dirty jobs (added)	
g.	Scientific analysis (added)	
h.	As a support tool to update data (added)	
i.	Not an effective tool	
у.	Do not use on-line, interactive programming	
z.	Other:	
a.	software development is? Not an improvement	
a.	•	
ъ.	Not an improvement Some improvement	
ъ. с.	Not an improvement Some improvement 1.5:1 improvement	
b. c. d.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement	
b. c. d. e.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement	
b. c. d. e. f.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement 5:1 improvement	
b. c. d. e. f.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement 5:1 improvement Very great improvement (not measured) (added)	
b. c. d. e. f.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement 5:1 improvement Very great improvement (not measured) (added) Do not know (added)	
b. c. d. e. f. g. h.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement 5:1 improvement Very great improvement (not measured) (added) Do not know (added) Not measurable (added)	
b. c. d. e. f. g. h.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement 5:1 improvement Very great improvement (not measured) (added) Do not know (added) Not measurable (added) Do not use on-line, interactive programming	
b. c. d. e. f. g. h.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement 5:1 improvement Very great improvement (not measured) (added) Do not know (added) Not measurable (added)	
b. c. d. e. f. g. h. i. y. z.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement 5:1 improvement Very great improvement (not measured) (added) Do not know (added) Not measurable (added) Do not use on-line, interactive programming	
b. c. d. e. f. g. h. i. y. z.	Not an improvement Some improvement 1.5:1 improvement 2:1 improvement 3:1 improvement 5:1 improvement Very great improvement (not measured) (added) Do not know (added) Not measurable (added) Do not use on-line, interactive programming Other: proximately what does it cost your firm to product a line	•

	a.	First year after delivery				\$	
	а. b.	Second year after delivery				<u>\$</u> \$	
	z.	Comment on trend:					
	۷.	Comment on Clena.					
emplorov indi	oyed idin cate	ch of the following procedure in software development act; g answers only rough approximif, in your judgement, the or decrease in the foreseea	ivities mations practic	in your are reque or prod	firm? ired.	In Also	
			<u>A</u>	<u>B</u>	<u>c</u>	<u>D</u>	<u>E</u>
roc	/Tec	<u>h</u>	Start	Discon	High	Pres	Inc/Dec
	a.	Team Concept [Baker, 1972]	<u>19</u>	19	%	%	
	b.	Devel Supt Lib [Baker, 1972]19	19	<u>%</u>	%	
	c.	HIPO's [IBM, 1975]	19	19		%	
	d.	Pseudo Code [Youndon, 1976]	<u>19</u>	19	9/ /0	%	
	e.	Walk thru's [Weinburg, 1971]	19	19		%	
	f.	Top Down Des. [Youndon, 1976]	19	19		%	
	g.	Top Down Impl [Youndon, 1976]	19	19		%	
	h.	Bottom up Design (added)	19	19	%	%	
	i.	Bottom up Implementation (added)	19	19	%	%	
	j.	Fire Fighting (added)	19	19	%	%	
	k.	Structured Programming (added)	19	19		%	
	у.	Don't use	[]	[]	[]	[]	[]
	z.	Other:	[]	[]	[]	[]	[]
4. ene		what stages in the development y required?	nt cycl	e are man	nagemen	t review	ws
	a.	System Requirements Review	(added)				[]
	b.	Preliminary design					[]
	c.	Critical design					[]
	d.	Module Design Review (funct	ion) (a	ndded)			[]
	e.		•				[]
		,					

	Final test (added)
h.	Completion of test and integrating plan (added)
1.	Completion of system test and user test phase (added)
j.	During emergency situations (added)
k.	Preselected milestones (added)
1.	Sporadic management audits (added)
у.	Do not employ management reviews
z.	Other:
n (ui	there any unique aspect to the principal function of your cless you are primarily a software development house) that been able to adapt to the software development task?
	been able to adapt to the software development task.

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APPENDIX C

COMMENTS ON AND ABBREVIATIONS USED IN THE REDUCTION OF ANSWERS

INTRODUCTION

The purpose of this appendix is to present comments on specific questions, relationships between questions and their answers, procedures used in contriving missing answers, and to list and describe the abbreviations and codes used in this report.

To conserve space and to provide a means of using a computer for analysis, all answers were abbreviated and/or coded (abbreviations and codes will be called just codes for the balance of this report). Because of space limitations and to assist in ease of processing, all alphanumeric codes were restricted to exactly three characters. The use of codes also had an additional advantage; it effectively disguised the answers so that the participants continue to remain anonymous.

The author did not comment on all the questions and answers. If the author had a comment, discussion, or observation on a question, his comments immediately follow the question number. Codes will immediately follow comments. If there are no comments, the codes will follow the question number. If the author has no comment or codes concerning a given question, the question number will be passed by.

Four types of codes were used. The first type was general, applies to all questions, and will be defined after this introductory section. The second type was applicable to only one answer and appears after the question number in this section. The third type of code was general across two or more questions (e.g., FOR for FORTRAN; GPC for general purpose computer), and was listed once the first time it is used. Therefore, all Type Two and Three codes were defined after the question number in which they first appear. The code was separated from its explanation by a dash (--).

The fourth code type applied to question 45. This question was strictly narrative in nature and did not lend itself to multiple choice. Each separate answer was given a separate code.

The author attempted to use codes that were easy to recognize (mnemonic) to reduce the amount of flipping between appendixes.

The letters a through z indicated the sub-parts of the questionnaire. Parts a through w were general questions. Part x was used to indicate the entire question was not answered (i.e., skipped). Part y was used primarily to show "none" of the answers applied or the questions were "not applicable". Part z was used for "other" answers.

TYPE ONE CODES

The code "YES" on the listing opposite a question (Sub-parts a through w) indicated that the surveyee "checked" the answer without comment and the answer is "yes" or "true." If a given question has a "blank" for an answer this indicates that the surveyee answered "no", or that the answer is "false" (this cannot be assumed if the surveyee did not answer at least one part in a multiple-part question).

Sometimes a pseudo question, Sub-part x, was created to indicate that the surveyee did not provide an answer to a given question because he: 1) did not understand the question, 2) felt it did not apply to his project or organization, or 3) just did not feel like answering it. This was done so that the reader would not read a "no" when the correct answer was unknown to the author. Sometimes the surveyee wrote in "unknown," otherwise it was coded "MIS" by the author.

When answered, Sub-part y was coded "NON" to mean that the whole question was answered "no" or "none". The answer to Sub-part y was frequently supplied by the author, therefore, one of the "C" codes was used (see later discussion). Sub-part z was coded "OTH" to mean that the surveyeequestion was not answered (i.e., skipped). Part y was used primarily to show "none" of the answers applied or the questions were "not applicable". Part z was used for "other" answers.

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Sometimes a pseudo question, Sub-part x, was created to indicate that the surveyee did not provide an answer to a given question because he: 1) did not understand the question, 2) felt it did not apply to his project or organization, or 3) just did not feel like answering it. This was done so that the reader would not read a "no" when the correct answer was unknown to the authors. Sometimes the surveyee wrote in "unknown" otherwise it was coded "MIS" by the author.

When answered, Sub-part y was coded "NON" to mean that the whole question was answered "no" or "none". The answer to Sub-part y was frequently supplied by the author, therefore, one of the "C" codes was used (see later discussion). Sub-part z was coded "OTH" to mean that the surveyee wrote in another answer and the author was not able to use it any other way (see discussion Appendix B).

As an added note, answers to Sub-parts a through w and z, Sub-part x and Sub-part y are mutually exclusive.

Several of the questions are multi-part. It is assumed that if a surveyee answered any one part of the multi-part question "yes" or "true" then all parts of the questions were answered. Any answers that were not checked were "no" or "false."

Other Type One codes are listed below. These codes were frequently used when the surveyee did not answer a question but made some comment in the margin. Other times these codes were used as the appropriate answer to a narrative question.

DEL -- Deleted by author as revealing the participant

INF -- Infinite, continuous, tog numerous to list

N/A -- Not applicable (on this project), didn't use

OTH -- Other

UNK -- Unknown (also included "?" as an answer)

VAR -- Variable

MIS -- Question not answered (supplied by author)

YES -- Yes or true

Upon occasion the author felt it necessary to either answer the question for the surveyee, or change his answer. In the interest of honest reporting, the following codes indicate whether or not the answer was changed/contrived and the reason. These change codes were CO1, CO2, and CO3. CO1 has the highest probability that the changed answers reflect the true answer, CO2 next highest probability, and CO3 the lowest probability. The change codes follow:

COl -- This answer was supplied by the author and the answer chosen was based on an answer to a different question, e.g., if the survey answered Question 3 with answer b, and he did not answer Question 21, answer 21y was provided by the authors as COl. Again, if the surveyee answered Question 24A but not 24B, answer 24By was coded COl by the author.

CO2 -- These answers were manufactured by the author by compartmentalizing answers provided originally in narrative form, i.e., multiple choice answers were formulated after all the answers were supplied by the participants. These answers were originally in narrative type questions or answers provided under "comments" or "other." An exception to this was when the participant wrote in "none" or another negative comment because a "none of the above" type answer was not supplied by the author. When this happens a "none" answer is manufactured but coded CO1.

CO3 -- These answers were redirected by the author from the one given by the surveyees as "other or "comment" to one of the existing answers which the author felt was equally as good as the one placed in "comment". This was done to reduce the number of possible answers while still retaining as much accuracy as possible.

TYPE TWO AND TYPE THREE CODES

This section reflects the specific codes and comments concerned with each question and are ordered by the question number. If there is no code or comment necessary for a given question, it is skipped.

- 2-5 Questions 2 through 5 are related. If any of these questions were answered "none" or "not applicable" and any of the other questions were not answered, answer y was coded CO1.
- 4 The following codes were used in answering this question (these same codes were used for Questions 5, 24, 28 and 29). When there appears to be a large number of identical positions that position is coded into the z answer.

Senior Corporate Officers

- VDR -- Director of Very Large Organizations
- VOP -- Vice President, Operations
- VPC -- Vice President, Data Processing
- VPE -- Vice President, Engineering/Function/Area
- VPG -- President or Vice President, General
- VPO -- Vice President, Organization of Physical Location

Senior Management

- MCN -- Center Manager
- MCP -- Senior Manager, ADP
- MDR -- Senior Director
- MEN -- Senior Manager, Engineering/Functional Area
- MGR -- Senior Manager, General (includes Division Manager)
- MLB -- Laboratory Manager
- MPA -- Assistant/Deputy Program Director/Manager
- MPD -- Senior Program Director/Manager (as opposed to Project Manager)

Project Management

- PAM -- Project Administration
- PEN -- Project Engineer
- PMA -- Assistant Project Manager, Deputy Project Manager
- PMC -- Project Manager, ADP/Computer
- PME -- Project Manager, Engineering/Analyst
- PMR -- Project Manager
- PMW -- Project Manager/Software
- PTD -- Technical Director/Manager

Middle Level Management (Second Level Supervisor, Chief)

- MAA -- Manager, Administration Applications
- MAD -- Manager, Administration
- MAS -- Assistant Manager
- MAT -- Manager, Advanced Software Technology
- MBA -- Manager, Business Applications
- MCD -- Manager, Computer Applications
- MCE -- Manager, Computer Engineering
- MEF -- Manager, Engineering Functions
- MGN -- General (unspecified) (Department managers)
- MIG -- Manager, System Integration
- MOS -- Manager, Operations
- MPC -- Manager, Project Control
- MSA -- Manager, Application Software
- MSC -- Manager, Scientific Applications
- MSD -- Manager, Software Development
- MSO -- Manager, System Software and Operations
- MSR -- Manager, Software Requirements
- MSS -- Manager, System Software
- MSW -- Manager, Software
- MTM -- Manager, Test

First Line Supervisor

- FAN -- Systems Analysis Supervisor
- FAP -- Applications Supervisor
- FCP -- Chief Programmer
- FEN -- Engineering Supervisor
- FLS -- First Line Supervisors, General (includes group leaders, task leader, section head, technical leader, manager, supervisor, head, etc.)
- FOP -- Operations Software Supervisor
- FOS -- Operations Supervisor
- FPP -- Project Programmers

- FSA -- Applications Software Supervisor
- FSD -- Software Development Supervisor
- FSE -- System Engineer Supervisor
- FSS -- System Software Supervisor
- FSW -- Software Supervisor
- FTC -- Team Chief
- FTM -- Test Supervisor
- FUT -- Utilities Software Supervisor

Lead ADP Personnel (includes Senior, Lead, Senior Project, Chief, etc.,

ADP Personnel

- LAP -- Lead/Senior Application Software Programmer/Analysis
- LOP -- Lead/Senior Operation Software Programmer/Analysis
- LPA -- Lead/Senior Programmer/Analyst
- LSA -- Lead/Senior Analyst
- LSD -- Lead/Senior Designer
- LSP -- Lead/Senior Programmer
- LSS -- Lead/Senior Systems Software Programmer/Analysis
- LUT -- Lead/Senior Utilities Software Programmer/Analysis

Lead Engineer/Functional Personnel (includes Senior, Lead, Senior Project,

Chief, Etc., Engineering/Functional personnel)

- LSC -- Lead/Senior Consultant
- LSE -- Lead/Senior Engineer
- LSW -- Lead Software Engineer

ADP Personnel

- CAN -- Analyst
- CAP -- Application Programmer Analysis
- CDA -- Data Base Analyst
- CDI -- Digital Computer Analysis
- CDS -- Data System Specialist
- CDV -- Software Developer
- CMS -- Software Configuration Management
- COP -- Computer Operations

- CPA -- Programmer/ Analyst
- CPR -- Programmer
- CSA -- System Analysis
- CSN -- System Programmer Analysis
- CSP -- Scientific Programmer
- CSY -- Systems Programmer

Engineer/Functional Personnel

- ECO -- Cognizant Engineer
- ECS -- Computer System Engineer
- EDG -- Designer
- EDS -- Software Development Engineer
- EIG -- Integration Engineer
- ENG -- Engineer/Functional/Designer
- ENS -- System Engineer
- ENT -- Test Engineer
- ESA -- System Analysis
- ESP -- Engineering Specialist
- ESS -- Systems Software Engineer
- ESW -- Software Engineer

Supporting Staff

- SAD -- Administration
- SDA -- Data Aid
- SLI -- Support Librarian
- SPC -- Project Control

General (Unspecified Personnel)

- WMT -- Member Technical Staff
- WOR -- Worker, Individual, Staff

Other Positions

- OCU -- Customer
- OMG -- Management Analysis
- OPI -- Pilot
- OSS -- Senior Scientist

- 5 The codes used in answering this question are the same as for Question 4 plus:
 - DIR -- Direct Line from Senior ADP Manager to Project Manager
- 10 The budget year (when supplied) is shown as the last two digits of the year preceded by a zero (e.g. 1971 is coded 071, 1975 is coded 075, etc.).
- 11-12 Questions II and 12 are related. If Question 11y is answered and Question 12 is not answered, 12y was coded CO1.
- 14 The number of people were reported in units according to the following method. The number of people, d(1), d(2), d(3), . . ., d(n) can be represented by d(1), $d(2) \times 10$ **R where R=N-2, was coded on the listing as d(1)d(2)R.
- 16-18 Questions 16 through 18 are related. If any of these questions were answered "none" or "not applicable" and any of the other questions were not answered, answer y was coded CO1.
- 20-21 Questions 20 and 21 are related. If Question 20b is answered and Question 21 is not, answer 21y was coded CO1.
- 24 The codes used in answering this question are the same as from Question 4 plus:
 - SAM -- The same as the question
- 28-29 The codes used in answering these questions are the same as for Question 4.
- 30 The following codes were used in answering this question. These are divided into 1) manufacturing codes and 2) software name. The software name was sometimes a proper name and sometimes a generic name.

Manufacturing Codes

- ADR -- Applied Data Processing
- CDC -- Control Data Corporation
- CFG -- Cain, Farber and Gordon
- CSC -- Computer Science Corporation
- DEC -- Digital Equipment Corporation
- FED -- Federal Simulation Center
- FST -- Foresite, Inc.

HAC -- Hughes Aircraft Company

HPK -- Hewlett-Packard Corporation

IBM -- International Business Machines

IDP -- Inovation Data Processing

INH -- In-house

ITI -- Illinois Technology Institute

KFT -- Kearfott

MRI -- MRI

NAN -- NANODATA, Inc.

TRW -- TRW, Inc.

UNI -- Sperry-Univac Corporation

Software Name Codes

AFL -- Automatic flow charter

ALL -- All that are Available

APT -- APT

ASS -- Assembler

BUG -- Debugger

CFM -- Configuration Management

COM -- Compiler

CSS -- CSS-II

DOC -- Documentor

DSL -- Design language

EAL -- Edit and load

EMU -- Emulator

ESC -- ECSS

FLI -- FLIT

FST -- Foresight

FUR -- FURPUR

GEN -- General tools

HIF -- HIFTRAN

IMS -- Information Management System

INT -- Intercom

LIB -- Library Aids

MON -- Software monitor

MTH -- Math package

MUL -- Multivendor

NAS -- NASTRAN

NET -- Network generator

OPR -- Operating system

PDL -- Program design language

PRC -- Process construction

PRO -- Project Dependent

PRT -- PERT planning

RCT -- Requirement code/traceability

REQ -- Requirements Analyses

RFI -- Remote File Indicator

RTX -- Real time executive

SPR -- Structural preprocessor

SPX -- SPREDEX

SSW -- System software

STA -- Standards construction

SYG -- System generators

S20 -- System 2000

TET -- Test tools

THR -- Threads Management System

TPN -- TPNS

TRL -- Translator

TSO -- TSO data set editing

TXE -- Test editors

UTL -- Utilities

31-33 Questions 31 through 33 are related. If any of these questions were answered "none," "not applicable," or "no" and any of the other questions were not answered, Question 31 would be answered "N/A," and Question 32b and 33y would be answered CO1.

32 The following codes were used to answer this question.

CNG -- Consultant Group

DPR -- Data Processing

EVG -- Software Evaluation Group

FSS -- System Software Supervisor

OUT -- Outside Organization

PTD -- Technical Director

SQA -- Software Quality Assurance

SWS -- Software Science

SWT -- Software Technology Group

SYS -- Systems Group

33 The following codes were used to answer Question 33bl. Answer to 33b2 was used only if two languages are reported.

ASS -- Unspecified Assembler

COB -- COBOL

FOR -- FORTRAN

JOV -- JOVIAL

PL1 -- PL/1

34 The codes used in answering this question are the same as for Question 30.

36 The following codes were used to answer this question:

COR -- Core requirements per program

CPU -- Computer usage per run

DRP -- Discrepancy report

KBU -- Number of known bugs

LOC -- Lines of codes (per time/dollar etc.)

MPT -- Manhouse per instruction (completed task)

NCT -- Number of compiles per task

NCU -- Number of compilable units

NSM -- Number of schedules met/jobs completed

PDO -- Pages of documentation

RES -- Response time (on-line terminals)

RWC -- Rate aided work charting

TAT -- Turn around time

TBZ -- Table sizes

TTC -- Time to complete task

37-40 Questions 37 through 40 are related. If any of these questions were answered y ("none") and not all of the other questions were answered, answer y was coded CO1.

43 The following codes were used in answering this question:

For Parts a and b the same method as for Question 10.

For Parts c and d the number represents the percent.

For Part e

INC -- Increase

DEE -- Decrease

STY -- Steady (no change)

Type Four Codes

- The following codes were used in answering this question:
 - B01 Freedom to change own product line hardware to benefit software.
 - B02 Provide simulated hardware interfaces early in design software groups participates in design of acceptance test devices.
 - B03 We are systems management oriented and sincerely believe that the same discipline which applies to the management of hardware development are applicable to software development.
 - BO4 The use of a software integration to integrate the functional equations (i.e. controls, guidance, etc.) into a Part I specification which takes target computer architecture and subsystem architecture into account.
 - BO5 Existing configuration control system for hardware has been adapted very effectively for software control.
 - BO6 Close/early coordination between engineering and software development personnel.
 - B07 Use of a system integration test start to integration and test hardware and software before starting test of the system in the vehicle. This qualifies the software for flight use.
 - BO8 Engineering discipline.

Appendix D

NARRATIVE AND CANDID (CLEAR TEST) ANSWERS TO SELECTED QUESTIONS INTRODUCTION

This section deals with actual, unaltered, answers provided to a series of narrative response questions, specifically, Questions 1, 2, 3, 4, 5, 24, 28, 29, 30, 32d 34 and 36. The narrative response questions asked for answers for which the author could not provide a set of answers, because of the wide variety of possible answers. Each discernible response, whether included in the following pages or not, has also been analyzed and coded to facilitate entry in the tabulation listing in Section 2. Since this reduction of comment to code destroyed some of the understanding, the author felt it worthwhile to include this "verbal" section in the report.

The answers as they appear in the following pages have been "cleaned up" to assure anonymity from the standpoint of author, firm, and project. Identical or nearly identical responses have been eliminated. With the exception of the "clean up" and correction of the most obvious spelling and punctuation errors, those responses included in the following pages are as received, and though they do not in every instance answer the question asked, they relate to the subject. As an aside, the author makes no claims to total understanding of every response.

QUESTION 1 What position do you hold in the company?

ANSWERS

The following answers are the various titles of personnel who answered the questionaire (grouped as to their relationship to the company).

a. Senior Corporate Officer

President

Assistant associate administrator for center operations (systems management)

Vice president of operations division

Assistant to the director

b. Senior ADP Officer

Chief, data processing

Branch chief

Chief, data computation

c. Senior Functional Area (Non-ADP)

Director, mission control and data processing

Director of engineering

d. Project Manager Software Development

Manager, mini/micro based systems department

Senior scientist, computer programming lab, ground systems group

Group supervisor

Software Systems program manager

Manager, operations, computer systems division

Software group leader

Program engineer for data systems

Engineering group head - software development

Supervisor of automatic test software section

Engineering software supervisor

Software engineer

Assistant chief engineer for computer resources

Laboratory manager

Engineering management

Manager, software development

Group engineer

Manager - product programming and development

Manager - software development laboratory

Manager - computer subsystems design

Manager, plans and control, data processing systems, system technology program

1st level manager

Chief engineer, digital computer and software engineering

Manager

Manager, software systems operations

Command and control manager

Department manager

e. Technical Director, Quality Assurance, etc.

Director, quality assurance

Technical director

f. Senior Corporate Staff

Applied mathematician

g. Project Individual

System analyst

Project individual

QUESTION 2 What is the title/position of the senior ADP officer in the firm?

ANSWERS

The following are the various titles of personnel listed on the questionaire (grouped as to their relationship to the company).

a. Corporate Officer

President

Vice president/general manager system engineering and integration division

Division president

Vice president of operating division

Vice president - software engineering

Vice president, aerospace systems

Vice president and director, computer systems division

b. Chief, Data Processing

Chief, data processing

Manager of software engineering

Manager of software development

Chief, digital computations

Manager, software development laboratory

Director, avionics control and information system

Director, data processing subsystems

Manager, business information system

Director of data processing

Director

Chief, computation division

Head, data processing center

Corporate director

Manager, information systems operations

Director, information processing

Manager, data systems services

Section head, computer programs

Department Head

Manager of engineering programming and computation department
Manager of programming and computation department
Director, administration
Director of computing and data processing
Division chief
Manager, information systems and computer services
Assistant director for automatic data processing
Software group leaders

c. Assistant Comptroller

Assistant associate administrator for center operation (systems management)

Assistant comptroller

d. Functional Area, Software Analysis

Software engineer

QUESTION 3 What is the title/position of the individual to whom the senior ADP officer reports (e.g., president, comptroller)?

ANSWERS

The following are the various titles of personnel listed on the questionaire (grouped as to their relationship to the company).

a. Corporate Officer

President

Vice president and general manager

Group vice president of parent organization

Vice president, engineering

Vice president, systems technology program

Vice president, finance

Senior vice president - technical operations

b. Comptroller

Comptroller

c. Senior Functional Area (non-ADP)

Director of engineering

Assistant manager, engineering operations

Manager, engineering operations

Manager, finance

Director

Director for research support

Director western data center

Director, systems engineering

Assistant lab director

Division manager, finance

Director of mission and data operations directorate division chief

d. Senior Corporation Staff

Associate administrator, center operations

Chief, avionics engineering

Branch head

Data Analysts

Data processing engineers

Senior scientists

Manager, advanced programming staff

Manager, software engineering and technology department

Manager, program production department

Manager, air defense systems department

Manager, SURTASS programming department

Manager, software production department

QUESTION 4 What are the titles/positions of the individuals reporting directly to the senior ADP officer? (e.g., chief, Software Development Division)

ANSWERS

The following are the various titles of personnel listed on questionaire.

Vice president

Manager, software systems operations

Manager, information processing operations

Center managers

Project managers

Manager, software requirements and analysis

Manager, software development

Manager, software test and development

Manager, software technology

Director, computer operations

Director, development

Director, systems integrity

Director, resources planning

Director, telemetry systems

Director, business development

Director, western operations

Director, project

Assistant to vice president

Staff assistant

Department managers

Manager, washington operations

Chief engineer, data control & processing subsystems

Project managers, software department

Director, management information system

Manager, plant engineering

Manager, office services

Chief pilot

Manager, administrative support center

Chief, management section

Chief, software development section

Chief, operations section

Director, ADP resources

Director, distribution and management systems

Director, requirements and material control systems

Director, technical support

Director, stock control and distribution systems

Lead programmer, utilities

Lead programmer, applications

Lead programmer, operating systems

Supervisor, utilities

Supervisor, operating systems

Supervisor, applications

Supervisor, test software

Chief, systems and operations

Chief, digital applications

Assistant to chief, digital computations

Department managers

Programmers

System analysts

Manager, computer operations

Manager, software engineering

Manager, plans and control

Supervisor, scientific applications software

Supervisor, scientific applications programs

Supervisor, scientific applications operations

Supervisor, business applications software

Supervisor, business applications programs

Supervisor, business applications operations

Supervisor, business systems analysis

Supervisor, hardware planning

Chief, computer engineering

Chief, computer programming

Chief, computer systems

Chief, instrumentation development

Director, central

Director, western

Director, eastern

Chief, operations intregation

Chief, management information systems software development

Manager, data processing division

Manager, scientific computing division

Manager, test data processing

Director, software department

Director, systems design

Manager, technology

Manager, operations

Software development staff

Operators

Chief, scientific applications branch

Chief, computer systems branch

Chief, computer operations branch

Chief, administrative applications branch

Chief of business systems

Chief of scientific/engineering data systems

Staff engineer

Unit head

Software supervisor

Sections chiefs

Mission operations computing division head

Information processing division head

Software engineers

Software group leaders

Director, ADP management office

Director, information systems office

QUESTION 5 What is a typical line of authority from senior ADP officer through Software Devleopment Project Manager?

ANSWERS

The following are the various combinations of personnel and line of authority listed on questionaire.

Laboratory manager; department managers; associate project managers

Vice president; operations director; program manager

Vice president; functional manager; project head

"Direct"

Division president; center manager; location manager; project manager

Vice president/general manager; manager, software systems operations; manager, large software project

Director; assistant director; project manager

Director, avionics control and information systems; chief engineer, data control and processing subsystems; manager, computer subsystem design; section chief, software design

Director; manager; branch chief, software development; section chief, programming function

Manager; supervisor; unit head; project manager

Automatic data processing officer; section head; worker

Corporate director; director; manager; chief; supervisor; project leader

Director; division manager, department manager; supervisor

Director, administration; director, management information system; manager system programming

Chief, data automation; chief, software development section; chief, products unit; software development project manager

Assistant comptroller; director, systems development; chief, development divisions; chief, development branches; software development project manager

Chief, digital computations; chief, digital applications; software development project manager

Software lab manager; department manager; section manager; software project manager

Division chief; branch chief; project manager

Chief; programmer

Section chief; group supervisor

General manager, business section; manager, programs section

Assistant director for ADP; director of missions and data operations directorate; mission operations computing division head; information processing divisions head

Chief, avionics engineer; software group leader; software engineer Senior ADP officer; director, information systems office; chief, systems development division; project manager

SPO chief; chief engineer; technical advisor for computer resources; computer systems engineer

QUESTION 24 (Part I) If possible, outline the composition of a typical large development team as it would be employed in your firm. To place the team in context, a hypothetical project description may be included (e.g., development of an on-line air cargo manifesting capability).

Hypothetical project description (optional):

ANSWERS (Part I)

The following is a list of descriptions shown on questionaire.

Develop a passive sonar system

Computer-aided dispatch system

Tactical command and control

Development of an on-line manufacturing material system for generating working paper to the shop floor during aircraft manufacture

Developing a crew training simulator system for a weapon system (e.g., aircraft weapons system)

Facilities specifications for tactical

Computer command and control plus intelligence

Development of a submarine sonar system

Uniform cost accounting

Requirements computation

On-line data collection

Airborne avionic weapons system

Develop a computer graphics oriented aircraft synthesis program

Conf. for flight software

Automating a world-wide network of tracking stations

QUESTIONS 24 (Part II) Fractions may be used to indicate that the position is not considered a full time job. The following is an example of the notation to be used if one individual occupies more that one position:

f.	Administrator			1/3	(g)
g.	Librarian	DESIGN	ASSISTANT	2/3	(f)

The letter in parenthesis is intended to tie the same individual to positions f and g.

Possible Title: a. Project Manager; b. Asst. Project Manager; c. Senior Analyst; d. Team Chief; e. Asst. Team Chief; f. Administrator; g. Librarian; h. Application Analyst; i. Functional analyst; j. Applications Programmer; k. Operation Systems Programmer, l. Tester; m. Integrator.

ANSWERS (Part II)

The following indicate typical development teams as shown in response to Question 24:

Project Manager, 1/3; Senior Analyst-Member of Tech Staff, 1/3; Applications Prog-Members of Tech Staff, 3 1/3

Project Manager, 1; Technical Director, 1; Department Managers, 3; Section Head, 7; Administrator, 1; Librarian, 1; Functional Analyst, 5; Applications Programmer, 20; Operation Systems Programmer, 5

Project Manager, 1; Assitant Project Manager, 1; Senior Analyst, 10-12; Department Manager, 3-4; Administrator, 1-2; Application/Programmer Analyst, 20

Project Manager, 1; Assistant Project Manager, 3; Work Package Manager, 6; Administrator, 1; Librarian, 1; Application Analyst, 5; Programmer/Analyst, 15; Quality Assurance, 1

Computer Analyst; Computer Specialist

Project Manager/Director, 1; Manager, 2; Senior Designer/Engineer, 4; Administration, 1/2; Application Analyst, 10; Applications Programmer, 30; Operations Systems Programmer, 5; Tester, 7.

Program Manager, 1; Deputy Program Manager, 1.

Program Manager, 1; Senior Analyst, 4; Administrator, 1; Application Programmer, 8 (Programmers in testers and integrator).

Project Manager, 1; Assistant Project Manager, 2; Senior Project Analyst, 6; Project Analyst/Programmer, 5; Digital Computing Analyst/Programmer, 2; Digital Computing Analyst/Operator, 2.

Project Manager, 1/2; Assistant Project Manager, 1/2; Team Chief, 1/2; Assistant Team Chief, 1/3.

Project Manager, 1; Assistant Project Manager, 1; Senior Analyst, 3; Team Chief, 2; Assistant Team Chief, 2; Administrator, 1; Application Analyst, 16.

Project Manager (cognizant engineer), 1; Assistant Project Manager (cognizant programmer), 1; Application Analyst (engineer), 1/3 (i & 1); Functional Analyst (engineer), 1/3 (h & 1); Programmers; Tester (engineer), 1/3 (h & i); Data Systems Integrator.

Program Manager, 1; Deputy Program Manager, 1; Systems Engineer Manager, 1; Software Development Manager, 1; Work Unit Leader, 10; Program Planner/Controller, 2; Configuration Management Specialist, 2; System Engineer/Analyst, 8; Functional Analyst, 8; Applications Programmer, 10; System Test Engineer, 3; System Integration Engineer, 3.

Project Manager, 1; Assistant Project Manager, 1; Senior Analyst, 2; Team Chief, 1; Assistant Team Chief, 1; Librarian, 1; Applications Programmer, 3; Operation System Programmer, 2.

Section Head, 1; Data Analysts; Programmers; Data Processing Engineers.

Program Manager, 1; Project Engineer, 1; Tech Director, 1; Task Leader; Administrator, 1; Programmers; Engineers.

Senior Analyst, 1; Administrator, 1/2; Applications Programmer, 2; Operation Systems Programmer, 2 1/2.

Project Manager, 1; Assistant Project Manager, 1; Senior Analyst, 1; Project Engineer, 3; Administrator, 2; Systems Engineers, 6; Scientific Programmers, 5; Hardware Engineers, 10.

Project Manager, 1; Lead Designer, 1; Chief Programmer, 1; Designer, 1; Programmer, 3.

Manager, 1; Assistant Manager, 1; Senior Systems Engineer, 4; Section Head, 2; Technical Staff, 3; Librarian, 4; Senior Programmer, 10; Programmer, 15; Software Test Engineer, 3.

Project Manager, 1; Technical Director, 1; Team Chief, 5; Administrator, 1; Librarain, 1; Application Analyst, 3; Functional Analyst, 3; Applications Programmer, 20; Operation Systems Programmer, 8; Tester, 5; Intregator, 5.

Project Manager, 1; Supervisors, 2; Senior Analyst (Team Leader), 3; Lead Programmer, 3; Data Aide (Documentation), 1 1/3; Librarian, 2/3; User Analysts (work for customer), 6; Applications Programmer, 15; System Intregrator Leader, 1; Data Base Designer, 1; Data Base Administrator (Procedures, etc.), 2; Transition to Production Interface, 1.

Computer Systems Engineer, 1.

Senior Systems Analyst, 1; Management Analyst, 1; Systems Analyst/Programmer, 1; Program Analyst, 2; Systems Software Engineer, 1/4.

Project Manager, 1; Data Systems Specialist, 3; Senior Programmer Analyst, 6; Administrator, 1/2; Librarian, 1; Application Programmer/Analyst, 20; Operation Systems Programmer/Analyst, 8; Tester, 6; Intregrator, 3; Documentation Aides, 3.

Project Engineer, 1; Senior Consultant, 1/3; Senior Engineer, 1; Librarian, 1 per 10 programmers; Programmer, 12.

Project Manager, 1;, Assitant Project Manager, 1; Senior Analyst, 5; Applications Programmer, 20; Intregrator, 1.

Project Manager, 1; Assistant Project Manager, 1; Team Chief, 3; Administrator, 1; Librarian, 1; Functional Analyst, 5; Applications Programmer, 8; Tester, 1.

Senior Analyst, 4; Application Analyst, 2.

Engineering Manager, 1; Project Engineer, 2; Project Leader, 3; Group Leader, 8; Administrator, 1; Software Engineer (Librarian), 1/2; Software Dev Engineer, 14 1/2; System Analyst (Application), 3; System Analyst (Functional), 8; System Analyst/Tester, 12; System Analyst/Intregator, 11; Staff Assistants to System Project Engineer, 2.

Project Engineer, 1; Engineering Specialist, 1; Supervisor, 1/2; Scientific Programmer, 5.

Project Manager/Software Engineer, 1; Senior Programmer, 2; Info Systems Analyst, 5.

Project Manager, 1/2 (1/2 supervising other work); Applications Programmer, 1; System Software Engineer, 2

Project Manager, 1; Assistant Project Manager, 1; Senior Systems Analyst, 2; Deputy Project Manager for Application Software, System Software, Data Base Development, Test and Evaluate, QA, Training, etc., 3-7; Administrator, 1; Librarian, 1; Systems Analyst, 4; Applications Programmer, 8; Tester, 6; Intregator, 6

QUESTION 28 Which Manual reporting procedures are used in project monitoring and management? At What level do they originate, and how how high do they go? How often were they aggregated, condensed, or eidted as they moved up the chain?

ANSWERS

Report Title	Lowest	Highest	No. of
	Originator	Recipient	AGGS/EDTS
Weekly Activity (Verbal) Project Status (Verbal) Significant Change	Indiv worker Indiv worker	Proj mgr Proj mgr	-
(Verbal)	Indiv worker	Proj mgr	-
Weekly Activity	Task mgr	Dept mgr	1
Project Status	Task mgr	Div mgr	1
Significant Changes	Task mgr	Div mgr	1
Weekly Activity	Software engr	Data proc mgr	none
Project Status	Software engr	Proj mgr	3
Significant Changes	Data proc mgr	Proj mgr	4
Weekly Activity	Worker	Customer	-
Project Status	Lead Prog	Chief, ADP	-
Significant Items	Senior Prog/Anal	Prog mgr	-
Performance Measuring Sys	Work package mgr	Customer	1
Variance Report	Work package mgr	Customer	
Weekly Activity Project Status Significant Change Crab Control Status Design Review Report Financial Report	Team ldr Supervisor User dept Test team Review team Proj mgr	Asst dir Director Ch rev board Carb cont bd Vice pres Vice pres	2 2 1 1 -
Weekly Activity	Ind contrib	Div gen mgr	6
Project Status	Ind contrib	Div gen mgr	6
Significant Change	Prog mgr	Div gen mgr	4
Monthly Activity	Programmer	Chief ADP	2
Project Status	Proj mgr	Chief, Organ	4
Weekly Activity	Group engr	Director	2
Weekly Activity	Section	Proj mgr	1 2
Project Status	Proj mgr	President	
Weekly Activity	Programmer	General mgr	3
Project Status	Programmer	General mgr	3
Significant Change	Programmer	Software mgr	2

Report Title	Lowest	Highest	No. of
	Originator	Recipient	Aggs/Edits
Weekly Activity Project Status Significant Change	Prog/Engr	General mgr	3
	Lead prog	General mgr	3
	Lead prog	Dir of engr	2
Weekly Activity	Analyst/Prog	Proj mgr	2
Project Status	Analyst/Prog	Proj mgr	2
Significant Change	.malyst/Prog	Proj mgr	2
Weekly Activity	Programmer	Proj engr	2
Project Status	Proj engr	Div mgr	
Weekly Activity	Engineer	D P Dir	-
Project Status	Engineer	Director	
Significant Change	Engineer	Director	
Weekly Activity	Lead engr	Proj mgr	4
Project Status	Software mgr	Proj mgr	2
Significant Change	Software mgr	Proj mgr	2
Weekly Activity Project Status Significant change	Prog/Analyst Prog/Analyst Prog/Analyst	Proj mgr Proj mgr Proj mgr	- -
Weekly Activity	Indiv prog	Proj mgr	2
Project Status	Proj mgr	Center mgr	5
Project	Proj admin	Varied	~
Weekly Activity	Programmer	Proj mgr	-
Project Status	Proj prog	Proj mgr	
Significant Change	Proj prog	Proj mgr	
Weekly Activity	Staff	Prog mgr	1-2
Project Status	Task leader	Customer	
Significant Item	Senior	Mgr	_
Weekly Activity	Proj mgr	Vice pres	3 -
Project Status	Lead prog	Vice pres	
Significant Change	Proj mgr	Vice pres	
Weekly Activity	Unit head	Director	3
Project Status	Programmer	Proj mgr	2
Weekly Activity	Programmer	President	5
Project Status	Lead prog	President	4
Weekly Activity	Sr analyst	Dir MIS	?
Project Status	Dir mis	Dir admin	?
Significant Change	Dir mis	Dir admin	?
Weekly Activity	MTS	Proj mgr	1 -
Project Status	Proj mgr	Asst vp	
Significant Change	Proj mgr	Asst vp	

Report Title	Lowest Originator	Highest Recipient	No. of AGGS/EDTS
Weekly Activity Project Status Significant Change	GP head GP head Section head	Prog mgr Prog mgr Prog mgr	2 2 1
Project Status Significant Change	Cog engr Cog engr	Sect chief Sect chief	1
Contract Progress Schedule Report - Semimonthly	Proj dir	ISO director	0
Keypunch Activity and Xerox Utilization Report - Monthly	Oper mgr	Oper chief	0
ADP - Daily Operational Report	Oper mgr	Oper chief	0
Financial Management Report	Proj mgr	ISO director	0
Administrative Status of Work Orders	Prog level	ISO director	2
Weekly Significant Activities Report	Proj leaders	ISO director	0
Analysis - Government - owned/Contractor Held Property	Proj mgr	ISO director	0
Contractor Organization and Personnel Report	Proj mgr	ISO director	0
Equipment Maintenance Records Report	Manufacturer's engineer	Oper chief	0
Commercial Time Share Activity Report	Proj mgr	ISO director	
Privacy Act - Contractor Personnel Access List	Proj mgr	ISO director	0

NOTE: ISO - Information System Office

 $\underline{\mathtt{QUESTION}\ 29}$ Which automated reporting systems were used in project monitoring and management?

ANSWERS

System	Lowest Originator	Highest Recipient
Manhour/Activity Manday/Task Manhour Accounting	Programmer Programmer Programmer	Chief, ADP Chief, ADP Chief, ADP
Manhour/Activity	Lead Engr/Prog	Director
Manhour/Activity Manday/Task	Analyst/Prog Analyst/Prog	Project Mgr Project Mgr
Manhour/Activity Manday/Task	Librarian Programmer	Dept. Mgr Project Mgr
Manhour/Activity Manday/Task	Software Engr SR Programmer	D P Mgr. Software Engr
Manhour/Activity Manday/Task	Engineer Engineer	Manager Manager
Manhour/Activity	Worker	Section Head
Manday/Task	Varies	Varies
Cost Data (Time cards)	Indiv	Div Mgr
Manhour/Task	Prog/Analyst	Project Mgr
Accounting System	-	-
Manday/Major Project Task	All Echelons	All Echelons
Manday/Task	Staff	Project Mgr
Manhour/Activity	Admin	Manager
Cost-Schedule-Controll- System	Worker	Customer
Manday/Task	Lead Prog	Proj Mgr
Manhour/Activity	Lead Prog	Proj Mgr
Manhour/System Function	Indiv Contributor	Proj Mgr
Manhour/Activity	Programmer	Chief, ADP
Pert Analysis	-	-
Manhour/Activity	Individual	The whole world

Tape/Disk Pack Library Report	Tape Librarian	Operations Chief	0
Daily Computer Utilization Report	Operations Manager	Operations Chief	0
Monthly Summarization of Computer Utilization Report (JARS)	Operations Manager	Operations Chief	0
Work Order Status Report (RMAS)	Programmer Level	ISO Director	0
Monthly Computer System and Services Usage Report (RMAS)	Programmer Level	ISO Director	0
Labor Distribution Report (RMAS)	Programmer Level	ISO Director	0
Periodic Resource Utilization Summary	Programmer Level	ISO Director	0

NOTE: ISO- Information Systems Office

QUESTION 30 Which commercial, or what locally developed software was employed to assist in the development task? (e.g. LIBRARIAN, Applied Data Research) (If system was of local origin, give very brief description, e.g. structural pre-compilen, automatic flow chart, etc)

ANSWERS

NAME (or description)	<u>VENDOR</u> (or description)
Threads Management System	CSC (V & V Tool)
Automatic Flowcharter	CSC
CMS-2 Structured pre- processor	
SHARE -7	USN
DEBUG	Fortran Debugger
DOCTOR	Fortran Source Documentation
FORFLO	Fortran Flow Charter
FORESIGHT	Forsight, Inc.
PERT/EXPERT	Planning package
MPS LIB II	Source edit & loader
SYM - II	Assembler
IMSL LIBRARY	Internal matl/Stat Library
NASTRAN	CSC
APT	ITI
Structured Pre-compliers	IBM
Requirement Language/Analyzer	TRW, Univ of Michigan
Prog Definition Language	CAINE, FARBER, & GORDON
Requirements - Code Traceability	TRW
Configuration Management	TRW
Process Construction	TRW
Standard Auditor	TRW
Timeshare/Text Editor	TRW
TESTS TOOLS	TRW
SPREDEX	CSC
CSS - II	IBM
ECSS	FEDSIM

NAME (or description

VENDOR (or description)

Various Cross Assemblers

are compilers

In-house

TSO Data Set Editing

Library Support Aids

IBM

IBM

Fortran Pre-processor

Competative In-house

Text Editors Flow Charters

In-house

Compilers

In-house

TSO/CRS/ATMS II/MVS

IBM

Cobol Compiler and library

IBM

Fortran Compiler and library

IBM

CVE/P-K/LAV

EDR/DSP

Boole & Babbage

Innovation Data Processing

System 2000

Psytran

MRI

IRS

Stat Programs for Social

Science

Sigma Data Computing Corp

SPSS, Inc.

Remote File Inquiry

Kennedy Space Center/IBM

Emulator

Emulate INTEL 3000 or 8080

Impact

Program activity network

generator

Auto Flop/Flow Charter

In-house

WYLBUIZ/Text Ed/For

IBM

Info Management System

IBM

Social Compiler System

Hughes

CMS-2 Support System

UNIVAC

HIFTRAN

HAL Pre-processor for IFTRAN

SPDL

Design language

SFTRAN, RATFOR, FORCE

Fortran pre-compilers

Utilities processors

TIDY, INDER, FURPUR

IBM

SSG

BTS, MFS

NAME (or description)

<u>VENDOR</u> (or description)

TPNS

IBM

FDR

Innovation Data

IMS IN? IRE

CGA

Librarian

ADR

Data Catalog

Synergistics

Mark IV & Mark IV-IMS

_ _

Bridge

Infomatics

QUESTION 32a Did the firm have a special organization or group that aided the project manager in selecting software development aids/packages?

ANSWERS

Title:

Software Quality Assurance Section
Software Sciences
Data Processing
Computer System Engineering Branch
Tech Advisor for Computer Systems
Software/Hardware Evaluation Group
Corporate Systems
User Consultant Group
Data Base Technology Group

Software Technology Group Director Tech. Support

COMMENTS:

Funded by R & D and projects
Occasionally assisted by another company division
Assistance available on voluntary basis from Data Processing Center
Individulas have own ADP "assets"
Informal Group

QUESTION 34 Which Software Development aids (e.g., copy library) supplied by the hardware manufacturer did you use to assist in application system development?

ANSWER:

NAME	MANUFACTURER
Assembler/Loader	Kearfott
Emulator/Simulator	Kearfott
FURPUR	Univac
Fortran Libraries	Univac
FLIT	Univac
ALL	DEC PDP-LD Operative System
ALL	CDC CYBER
QM-1 Emulators	NANODATA
Compliers, Assemblers, Math Routines	CDC
INTERCOM	CDC
IMS	IBM
ALL	Multiple
All Available	
Many	IBM, CDC, UNIVAC, DEC, OTHERS
Systems Software	IBM
Documentation	CDC
Packages	
CSS-II	IBM
ECSS	FEDSIM
Various Cross Assemblers & Compliers	Mostly in-house
TSO Data Set Editing	IBM
Library Routines	IBM
Standard	OS and utilities
Fortran	
Editors	
DeBug	

NAME

MANUFACTURER

Sys Gens, Memory Maps, Dumps

Fast Dump Restore

Innovation Data Processing

Sys 2000 DBMS (Not long)

MRI

IRS

Sigma Data Computing Corp

RFI

Kennedy Space Center IBM

Text Editor

Any HP

O/S - RTE

111

0/S

IBM

CMS-2 M & V Support Package

Univac

IMS

IBM

TPNS

IBM

BTS, MFS

IBM

DB PROTOTYPE

IBM

QUESTION 36 List manually derived productivity indexes such as lines of code, program errors, turn arounds required per completed task, etc., that you employed in monitoring performance.

ANSWERS:

Lines of code
Time to complete program module
Number of compilable units
Manhours/Instruction
Factors for type SW
Real time application

Support SW, compilers

Assy's

Discrepancy reports

Computer usage for checkout

Turn around time

PP time

CA time

Response time (on line terminals)

Number of known bugs

Core requirement changes for code

Lines of completed code generated

Number of complies/completed task

Number of manhours expended/completed task

Number of schedules met/completed task

Pages of documentation generated/completed task

Table sizes

2.5 compiles per program through implementation

Jobs processed per month/manhour

Test hours/programmer/month

Time to complete

Rate aided work checking

Dollars/lines of operational, documented code

L.O.C./unit time

Lines of code should not be used in monitoring performance



CALIFORNIA STATE UNIVERSITY. SACRAMENTO

6000 | STREET, SACRAMENTO, CALIFORNIA 95819

August 1, 1981

TO: Participants in the AIAA Project Management Survey

Enclosed is SM-ALC/MME TR 79-54, Volume I, dated 18 Dec 1979, which reduces and formats data from the survey in which you participated. A limited number of copies were printed and generally only participants in the survey are sent a copy of this data. In addition, a copy of this report and the machine listing of the data will be forwarded to:

RADC/ISISI
GRIFFISS AFB, NY 13441

(315) 336-0937 AUTOVON 587-3395

for retention in the RADC Data & Analysis Center for Software. This is the last volume in the report and one of the more interesting. Data from this volume has never been used in any paper or report.

A paper using data from Volume II will be published in the July issue of The IEEE Transactions on Software Engineering. Another paper from Vols. II and III will also be published in the Transactions next spring. A companion paper "The Challenge of Software Engineering Project Management" was published in Computer, August 1980. A paper "Organizational Structures Used in Software Development by the U. S. Aerospace Industry" which used data from Volume II was published in The Journal of Systems and Software 1, 283-297 (1980). And lastly, Art Pyster from the University of California at Santa Barbara and a are working on a project management reference book entitled The Pitfalls of Software Engineering Project Management: In Defense of the Project Manager, that will use the project management data along with other information.

Arthur Pyster, UCSB, and I are still soliciting professional level papers on the practical aspects of software development and project management to be published in a special issue on project management in the Software Engineering Transactions, Spring 1982. If you have such a paper or are interested in writing one, please contact the editor, IEEE Transactions on Software Engineering, Les Belady or myself.

Since this is probably the last correspondence you and I will have concerning the AIAA Project Management Survey, I want to thank you most heartily for your support over the past four years. If you have any comments or questions, you can contact me at home (916) 481-5482 or at the University (916) 454-6834.

Sincerely,

Richard H. Thayer, Ph.D.

Lecturer in Computer Science

Encl.
THE CALIFORNIA STATE UNIVERSITY AND COLLEGES

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